SPORLAN

[illegible] most complete line of
PEAK PERFORMANCE PRODUCTS FOR

AMMONIA REFRIGERATION SYSTEMS

THERMOSTATIC EXPANSION VALVES and REFRIGERANT DISTRIBUTORS
for Direct-Expansion Systems

LEVEL MASTER CONTROLS
for Flooded Systems

SOLENOID VALVES

Be sure to get
SPORLAN CATALOG 59A
from your friendly Sporlan Wholesaler
It gives you all the facts on
Sporlan Peak Performance
Ammonia Products

CATCH BASINS

STRAINERS

BACK PRESSURE REGULATORS

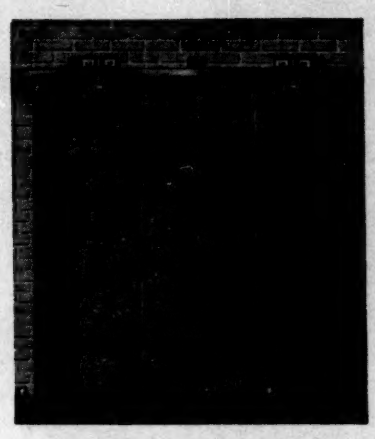
SPORLAN VALVE COMPANY
1526 Hussey Avenue [illegible]
Export Dept. 11 Broadway New York

THE INDUSTRY'S FINEST...

ALL TYPES

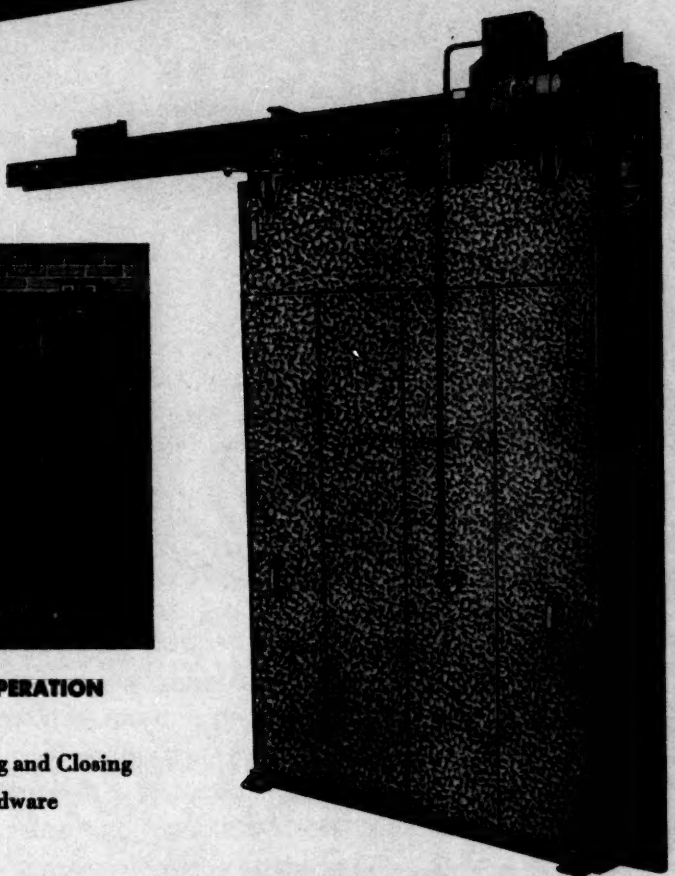
AIR OPERATION

- Safety Entrance and Exit Through Built-In Refrigerator Door
- Speedy Opening and Closing



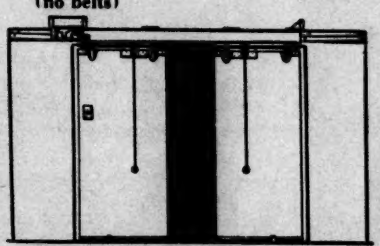
MANUAL OPERATION

- Dependable
- Easy Opening and Closing
- Durable Hardware



"Electro" SAFETY SLIDE

- Structural Simplicity
- Mechanically Sound
- Exclusive Automatic Sealing
- Gear Type Uni-Brake Motor Operation (no belts)



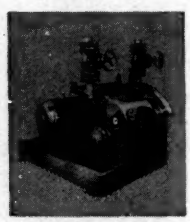
BI-PARTING "ELECTRO" SAFETY SLIDE DOORS

- Recommended where space factors dictate their use
- Gear Type Uni-Brake Motor Operation (no belts)

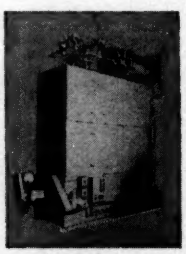
Write for descriptive bulletin . . .

Right now, at this drawing board, tomorrow's refrigeration products are being engineered today! Products that will solve the urgent demands of industry... more efficiently and more economically. Now, as it has since 1922, Kohlenberger is leading the refrigeration industry with pacesetting developments and techniques. And 1960 looms as Kohlenberger's biggest year of progress. Write for details: **Kohlenberger Engineering Corporation, 1600 West Commonwealth Avenue, Fullerton, California.**

WATCH KOHLENBERGER IN 1960



KMV Refrigerant Compressor: 20-200 H. P.



Revolutionary new Krakice Maker, 10-60 ton capacity

Kohlenberger designed and built freezer storage plant

Industrial Refrigeration

October 1960

H. T. McDermott
Publisher

H. D. Busby
Editorial Director

ADVERTISING
O. Rhodius Elofson, *Director*
Edw. Davieson, *Representative*

H. B. Smith
Secretary

E. P. Swanson
Subscription

V. S. Smith
Production

INDUSTRIAL REFRIGERATION, Published monthly at 433 N. Waller Ave., Chicago 44, Ill., U.S.A., by Nickerson & Collins Co. Yearly subscription in the U.S., $5.00 per year; other countries, $7.50. Single copies, $1.00. Copyright 1960 by Nickerson & Collins Co. Acceptance as controlled circulation publication at Chicago, Ill., and Pontiac, Ill.

CHANGE OF ADDRESS—Notify publisher and your local post office promptly of change of mailing address to avoid non-receipt of copies. Copies incorrectly addressed, because of failure to notify publisher, cannot be replaced. Upon request, post office will provide, without cost, convenient "change of address" mailing cards.

Industrial Refrigeration is indexed regularly by Engineering Index, Inc., and is microfilmed for library use by University Microfilms.

A NATIONAL MAGAZINE FOR:
- **Plant Engineers and Operating Personnel**
- **Application Engineers and Contractors**

WHERE REFRIGERATION EQUIPMENT IS USED FOR:
- **Food Freezing, Storage and Transport**
- **Processing and Cooling Applications**
- **Research and Development**

Contents of this Issue

New Freezer Storage In Chicago Employs New Ideas 4

Handling Plum Pudding or Fruit Cake 4

Don't Use CO_2 To Test Ammonia Systems 6

Grant For Research On Nitrogen Freezing 6

News Briefs of the Month 9

How to Use Time-Temperature-Tolerance Findings In Frozen Food Handling *By Dante G. Guadagni* 10

Some Economics On Liquid Nitrogen for Tomorrow's Frozen Foods 15

Automatic Control of Pressure In Refrigerating Systems 16

New Products Designed to Improve Operation 26

Manufacturers News 29

Published Monthly by NICKERSON & COLLINS Co.
General Offices: 433 N. Waller Ave., Chicago 44, Ill.
Telephones: AUstin 7-1303-04-05

69 Years of Continuous Publication

New Freezer Storage In Chicago

Employs New Idea In Refrigerating System

»» CONTINENTAL Freezers of Illinois an affiliate of Trans-American Refrigerated Services, Ltd., has announced the construction of a new modern freezer storage. The 83,000 sq. ft. building includes docks, offices, lunch rooms, locker rooms and equipment area. It includes minus 10° freezers in two bays each 200 ft x 100 ft x 23 ft high. There are also 40° coolers in two bays each measuring 120 ft x 100 ft x 23 ft high. These coolers are separated from the freezers by an insulated wall and may be converted to minus 10° freezers.

Refrigeration evaporator units and air ducts are compactly set between steel trusses, thus allowing maximum stacking heights and protection from damage by fork lift trucks. Units installed in this manner occupy no revenue space. Under the refrigerated floors there is a 4-ft air space for air circulation to prevent the ground from freezing and thus avoiding heaving of floors. Each refrigerated area has a reinforced concrete curb six inches high around the perimeter of the rooms. This prevents damage to insulation and storage of merchandise too close to walls. For quick access to all refrigerated areas ten automatic super-freeze overlap doors are installed.

Both the railroad and truck loading docks are enclosed. The railroad dock measures 20 ft x 320 ft and the truck dock 30 ft x 320 ft. Docks have insulated ceiling and are air cooled to avoid loss of temperatures during loading and unloading.

The roof of the structure is insulated with 10 inches of blue Styrofoam; walls contain 8 inches of fibreglas and floors 8 inches of blue Styrofoam. This it is believed will provide lowest temperatures at minimum refrigeration costs under the most extreme conditions expected to be encountered. The machinery space is located in a non-revenue space above the railroad and truck docks. Housed here are two separate refrigeration plants of latest design developed by Burge Ice Machine Company. The equipment and the manner in which it is installed employs a principle similar to packaged equipment in the home or for commercial applications. It is believed that this is the first attempt to use the idea in larger industrial refrigeration.

The refrigerating units which are fin coil evaporators are suspended between the trusses just inside the freezer walls so that except for a few feet of pipe reaching through the freezer wall from the compressor space to the evaporators, there are no ammonia lines in the refrigerated areas. Two cooling towers located on the roof above the machinery space again occupy a non-revenue space.

Compressors, motors, etc., contained in the machinery room total approximately 200 horsepower. The ammonia refrigerating equipment is of the 2-stage liquid recirculating type and is packaged as a self-contained unit. It is completely automatic and will not only regulate its own operation according to demands of the room temperature but will summon the engineer in charge when service is needed and tell him the locality of the trouble. This is done through the means of colored lights on a panel.

The installation was designed and installed by Burge Ice Machine Company under the supervision of A. Epstein and Sons, Architects. It was manufactured by the Chicago Stock Yards Turbo Refrigerating Company.

Handling Plum Pudding Or Fruit Cake

»» MANY bakers are beginning to plan their production of plum pudding and fruit cake for the Christmas season, according to The Refrigeration Research Foundation. To save a production rush at the Holiday time, some bakers have found it profitable to manufacture these items during slack periods in the summer and early fall and then hold them at cold temperatures until needed.

Plum pudding and fruit cake, from most recipes, have a low moisture content, high percentage of sugar, dried and candied fruit, and are heavily seasoned. All of these things result in a product that does not spoil as readily as other desserts, and off-flavors are not a problem. However, molds will form on the surface of these products and make them unsaleable.

Mold spores floating in air drop onto bakery products when they are cooling but, due to the dryness of the surfaces, they cannot grow. However, if water droplets condense on the surface of the product, they provide enough moisture for the molds to grow and the resulting white or colored spots spoil the appearance. The product is edible and will not be off-flavored, but the appearance is unsightly.

Any technique which will prevent condensation on the surface of the product when moved into a cooler temperature will then permit the product to be stored above freezing temperatures for several months without loss in quality. The method usually used to accomplish this is to pack the products in a room having a low relative humidity (approximately 40 or 50%), using a moisture-proof package for each cake.

If it is not possible to have a low humidity within the individual package and overwrap in a moisture-proof wrapper, mold can be expected to form in from 10 days to 4 weeks when held at approximately 35°F. Freezing of the product is the only other solution to the prevention of mold formation. Temperatures of 15°F. or below are used, and both plum pudding and fruit cake maintain good quality.

New Approach To Controlling Food Spoilage Being Studied

»» THE Refrigeration Research Foundation announces that under the direction of Dr. Harold Schultz, member of The Foundation's Scientific Advisory Council, research has been initiated on a new approach to the control of food spoilage. Dr. Schultz is chairman of the Food Technology Department at Oregon State College in Corvallis. The research grant is from the United States Department of Public Health, Education and Welfare, to study the food preservation properties of Vitamin K 5.

Vitamin K 5 is the only vitamin known to destroy spoilage agents in food. It is found in green leafy vegetables, cheese, liver, egg yolk, and tomatoes. Heat does not destroy the vitamin and it is possible that by adding it with freezing and canning methods, the refrigerator shelf life of foods may be extended as much as six weeks after exposure to air.

Nutritional Evaluation Of Food Processing

»» THE argument is outmoded that Grandma's Apple Pie is a delicacy not to be duplicated. Quartered apples, as we know now, ordinarily lose 20% ascorbic acid in 1 to 2 hours, and 33% in 3 hours, at 25 degrees C. They retain 40% ascorbic acid when baked 60 to 90 minutes at 204 degrees C in an open dish. The retention is 25% during baking in a covered dish and only 20% during baking in a pie. Grandma's art was insufficient. With these facts at hand, modern food scientists are able to look for the proper countermeasures. Apple Pie may at last be on its way toward becoming a true gourmet's delight.

The index of "Nutritional Evaluation of Food Processing" (Wiley, 612 pages, $12.00) lists 26 references to apples alone, not to mention the array of other fruits, vegetables, milk, cereals, oil, meat, poultry, fish, and other foods whose nutritional characteristics fill the pages. The new book contains the work of thirty-three specialists under the joint editorship of Robert S. Harris of the Massachusetts Institute of Technology, and the late Harry von Loesecke.

Under the scrutiny of this combined authorship, food changes become less mysterious. Processing—washing, bleaching, dehydration, canning, pasteurization, frosting and defrosting, baking, mashing, and ultraviolet and gamma rays, among other procedures—often deletes essential vitamins and minerals. These, however, can be preserved or restored by up-to-date processing methods. The volume therefore gives suggestions for altering certain processing procedures in order to minimize losses in nutritional value.

Among the salient topics covered in "Nutritional Evaluation of Food Processing" are the effects of agricultural practices on food composition, the effect of commercial processing, losses in nutrients in home preparation of foods and in large-scale preparation, and the effect of packaging materials on the maintenance of nutritive value.

MORE EFFICIENT

SAFER

PROTECT EQUIPMENT

SIMPLIFY MAINTENANCE

SAVE MONEY

NEW PHILLIPS

REFRIGERATION CIRCULATING and RETURN SYSTEMS

• substantially reduce operating costs through—more efficient use of all components . . . complete protection of compressors, more efficient heat transfer, central liquid control . . . save operator time.

• adapt to existing plants with only minimum additional equipment—uses your present components to good advantage, nothing to tear out!

• adapt to new construction by simpler, more efficient system design—fewer components required!

• controlled low pressure is the secret that permits complete flexibility in the use of equipment—you can use automatic float controls or simple hand valves . . . facilitates hot gas defrosting as well as oil return, etc.—no high cost components needed!

. . . NOW

See your Phillips Representative or write for details

H. A. PHILLIPS & CO., 3255 W. Carroll Ave., Chicago 24, Ill.

DESIGNERS AND ENGINEERS/REFRIGERATION CONTROL SYSTEMS

Don't Use CO_2 To Test Ammonia Systems

››› TO THE old ammonia men this is probably an old story but to those men who have been accustomed to dealing with other refrigerants, with an occasional ammonia application, the following may be "a stitch in time that saves nine".

According to a correspondent's communication an additional ammonia compressor was being connected to an ammonia plant which had been in operation for a year. Connections were being made to closed shut-off valves which separated the new system from the old. CO_2 was used to pressure test the new section of the system. It was noticed that the CO_2 pressure was gradually reducing after a few hours although no leak could be found in the system.

Checking on the old compressor it was found that it was jammed and when it was opened it was found that part of it was covered with a white crust. The same condition existed in the suction and discharge lines and in all valves. Some areas were completely full of this salt-like material. It is not hard to imagine that a terrific job was encountered in cleaning up the entire refrigerating system.

In trying to reconstruct what had happened it was assumed that the two shut-off valves separating the old system from the new section and which had been tight before, had begun leaking during the leak test with CO_2. This probably occurred when the CO_2 pressure exceeded the ammonia pressure. CO_2 then leaked in and mixed with the ammonia of the old system and after the CO_2 pressure was released the ammonia probably leaked into the new system mixing ammonia and CO_2 throughout both systems. The result was the formation of the salt-like solid compound. The installers had been accustomed to handling Refrigerant 12 or 22 plants and had frequently used CO_2 as a convenient and harmless gas for leak testing. It had also been used in newly installed ammonia plants. However in the latter case no ammonia was in the system and all the CO_2 was removed before the system was charged with ammonia.

CO_2 and ammonia do not mix. Therefore it should not be used for leak testing if any ammonia vapor is present in the system.

Colorado College Awarded T.R.R.F. Grant For Research On Nitrogen Freezing

››› ACCORDING to their August Information Bulletin The Refrigeration Research Foundation has just appropriated $2,000 for the initation of cryogenic research on foods at Colorado College in Colorado Springs. This is coincident to the establishment of a $1,500,000 science building, by the Olin Foundation, for coordinated teaching and research in physics, biochemistry and biology.

The word cryogenci, under present usage, means extremely low temperatures, in the range of -300° F to -400° F, developed by liquid nitrogen and other liquid gases used as refrigerants.

In the development of vehicles for probing outer space, it became necessary to utilize extremely low temperatures for the use of and the holding of the propellants to get the vehicles into space. Equipment was developed for the liquefaction of gases and in this liquid state they are extremely cold.

As this equipment was developed, the manufacturer began to seek other means for these materials to be used as a refrigerant. The frozen food industry was a natural field to explore.

The use of liquid nitrogen, along with other liquid gases, for the freezing, shipping, and holding of foods has been reported.

Over a year ago Director W. A. Maclinn of TRRF anticipated this development and began an intensive survey of what was known about the damage that might be done by normal refrigerated warehouse handling practices, to foods that had been subjected to the shock of these low temperatures. There obviously had been no experience with these foods, nor was there any research in progress.

When Foundation funds became available, the executive committee authorized the money to initiate this study, to get answers to the following questions:

1. What happens to the quality of foods frozen at a temperature of around -400° F, that are then held at 0° F?
   A. Is there excessive drip?
   B. Is the color changed?
   C. Is the texture harmed?
   D. Are flavor changes accelerated?
2. What happens to the quality of standard frozen foods subjected to a shot of liquid nitrogen or CO_2 snow for quickly reducing the temperature of the food when it gets above 0° F?
3. Are fragile foods, such as peas, strawberries, etc., at extremely low temperatures going to shatter when handled in a warehouse?
4. Are the present food packages (transparent films, waxed cartons, composite containers, paper bags, fibreboard cartons, etc.) when subjected to the shock of these low temperatures, going to be brittle, or have the strength to with stand handling and stacking?

The modest sum available for this study will not get all of the answers to these questions immediately. However, research has been initiated to get information to protect the interests of the members of this Foundation.

Frozen Foods, Properly Handled, Not A Health Hazard

››› ACCORDING to The Refrigeration Research Foundation scientific investigations over the years have proven the principle that freezing temperatures prevent illness-causing (pathogenic) bacteria and non-pathogenic bacteria from reproducing (growth) and also prevent them from producing the by-products of their living processes which when consumed result in illness. The bacteria are not killed, although some of the weaker strains may not survive. The bacteria, in general, lie dormant until returned to a more favorable environmental temperature.

Recent U.S.D.A. research on fro-

zen vegetables shows that there was absolutely no growth of bacteria at storage temperatures of +20°F. or below. However, there was growth at +25°F. and above and therefore there is the possibility of production of illness-causing by-products of their living process at these temperatures. The bacterial population on the vegetables doubled in one to eight weeks at +25°F. and +30°F., and in less than one week at +40°F.

The vegetables were peas, green beans, cauliflower and spinach from commercial packing plants in the principal producing areas of the United States. Samples were stored at temperatures from −20°F. to +40°F. and tested at intervals up to 3½ years. As would be expected from the Time-Temperature Tolerance studies of the U.S.D.A., flavor and color deterioration did occur during the storage studies even when there was no bacterial growth.

Again, research proves that good handling practices for frozen foods, as outlined at this Foundation's series of Seminars held earlier this year, prevents frozen foods from becoming a hazard to human health.

Quincy Market of Boston To Build New Freezer Plant

»» QUINCY Market Cold Storage and Warehouse Company of Boston, one of the oldest refrigerated warehouse companies in the country, announces the plans for building a new million cubic feet, water-front freezer-facility in Gloucester, Massachusetts.

Herbert Farnsworth, President of Quincy Market indicated that this expansion of the refrigerating facilities, already existing in the two Gloucester plants of his company, is intended to improve and augment its services to fish processing companies and to provide for the growing import-export business.

State Improves Harbor

A bill in the Massachusetts Legislature to appropriate $500,000 for dredging the harbor area to permit ready access of small freighters has been passed by both legislative houses. The Gloucester Industrial Development Commission has cooperated closely with Quincy Market in making possible this undertaking, which includes also a dry storage warehouse.

A new wharf, some 300 feet long, will be built to accommodate easily the freighters, engaged in import-export shipping. It is planned to have the new facility ready for operation by June 1, 1961.

Editorial comment on this project reflects much civic enthusiasm. The Gloucester Daily Times states that with the approval of this undertaking, "Gloucester may have crossed the threshold into a new era".

Quincy Market in addition to its Gloucester plants, in one of which Gorton's of Gloucester, the well-known fish processing company operates its Seafood Center, has plants in Boston and Watertown, in Portland, Maine and in Troy, New York. The Company was incorporated in 1873 and has been a progressive leader for many years in the field of refrigerated warehousing, refrigerated trucking and allied services.

Book Review

LOW TEMPERATURE TECHNIQUES By F. Din and A. H. Cockett. 216 pages, Hard Bound, published by Interscience Publishers, Inc., New York. Available from Nickerson & Collins Co., 433 N. Waller Ave., Chicago 44, Ill. Price $6.50.

This book has been written to provide a source of up to date information about the principles and practice of low temperature techniques. The emphasis throughout is on the practical aspects of these techniques, which are becoming of increasing importance for many experimental and industrial applications.

Mathematical symbolism and theoretical jargon are kept to a minimum. There are no references; instead, recommendations are made for further reading. Where exact figures are quoted, e.g. for the triple points, boiling points, etc., of gases, these figures have been selected with care in the belief that they are the best available at the time of writing.

The book will prove of real value to students, laboratory workers and technologists in all scientific and industrial fields.

The Authors

F. Din, one of the authors, has been with British Oxygen Research and Development since 1946. Formerly he was with the 'Triplex' Safety Glass Company, Ltd., Birmingham, England. He studied at Imperial College of Science and Technology and is a member of the Faraday Society and the Physical Society and of the British Association of Chemists.

A. C. Cockett studied at Queen Mary College, London, England. From 1940 to 1948 he was with Electroflo Meters Co. Ltd. as a physicist in the research department concerned with the design and manufacture of industrial instruments with special interest in pyrometry. He then joined British Oxygen Research and Development, Ltd., where he applied his knowledge of thermometry to the measurement of low temperatures. He is now engaged in physical and physical-chemical research at low temperatures.

Marketing Specialist Added To Faculty

»» DR. EDWARD M. Barnet, Professor of Business Administration and Director of Programs in Mass Marketing Management and Food Distribution Administration, of Michigan State University, has been added to the faculty of the Management Development Course for Dairy Executives according to an announcement by Dr. Earl Strong, IAICM Educational Consultant and Director of this training program. Dr. Barnet, a well known authority in the field of marketing, will conduct the session on "Productivity, Survival and Growth," offered during the second week portion of the course, which will be offered at the Granville Inn, Granville, Ohio, November 13-19, 1960.

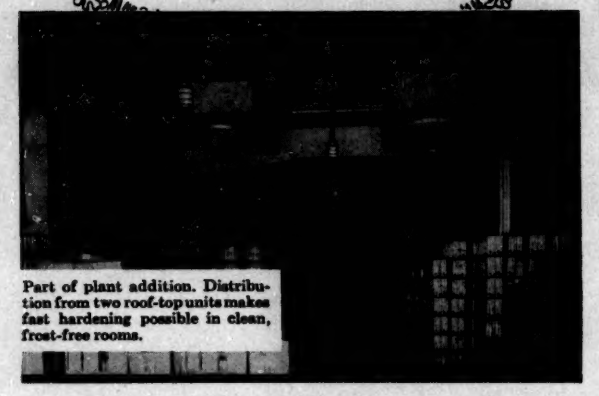
The Management Development Course was developed under the auspices of the International Association of Ice Cream Manufacturers. Co-sponsoring this training activity are the following associations: American Dry Milk Institute, Dairy Industries Supply Association, Ice Cream Merchandising Institute, Milk Industry Foundation and the Ohio Dairy Products Association.

DAIRYMEN'S ASSOCIATION LTD., HONOLULU . . .

Enlarged ice cream manufacturing plant locates

KING UNITS

on roof for increased hardening room capacity



Part of plant addition. Distribution from two roof-top units makes fast hardening possible in clean, frost-free rooms.

During the recent expansion of this fine ice cream manufacturing plant in our newest state, Dairymen's Association, Ltd., replaced a troublesome system with a trouble-free King Sharp Freeze installation.

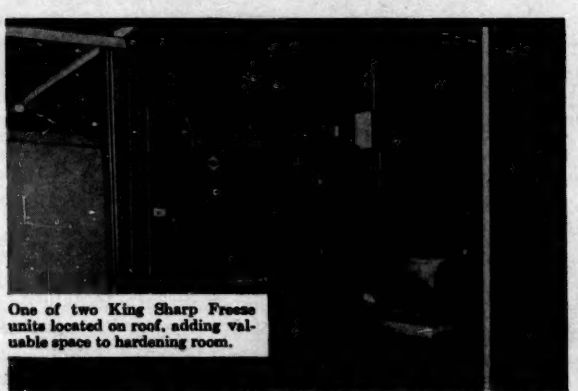
Improvements brought about by the King system are:

1 Four floor type blower units, previously occupying valuable space in the hardening room, have been replaced by two King Sharp Freeze units located on the roof above the room.

2 A 25° to 30°F. room temperature rise during defrosting of the old units has been eliminated with the King Sharp Freeze installation, improving the product texture immeasurably. This is possible because the King units are independent of the room during defrosting.

3 Frost problems in the hardening room, due to the very high humidity in Hawaii, have been alleviated completely.

Why not find out how King engineers can reduce sharp freezing and storage costs, help you maintain high quality products and improve your handling operation? More than 50 years' experience on installations in over 60% of the nation's largest plants, is at your service.



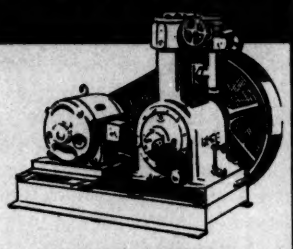
One of two King Sharp Freeze units located on roof, adding valuable space to hardening room.

Write for free technical bulletin

King COMPANY OF OWATONNA

907 N. Cedar St., Owatonna, Minn.

STAY AHEAD OF COMPETITION HERE'S HOWE!

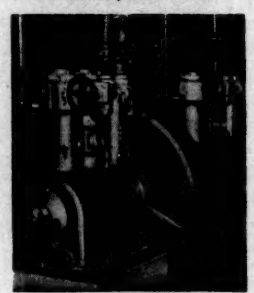


COMPRESSOR ASSEMBLIES
Capacities to 60 H.P.

HOWE REFRIGERATION works in so many fields—where compressors and components have vastly different jobs to do—that experience gained in one field often helps solve problems in other fields.

POLAR CIRCLE COILS
For freezer storage as well as normal temperature work

HOWE'S broad and long (48 years) experience is one way our engineers can help you stay ahead of competition. Let us demonstrate the value of this specialization by bringing you more efficient operation and better profits. *It pays to know HOWE!*



HOWE COMPRESSORS
For every size load and application. 5 to 150 tons

WRITE FOR LITERATURE

HOWE 3-Fan UNIT COOLERS
For heavy duty, high tonnage blast freezing, freezer storage.

HOWE ICE MACHINE CO.

2829 MONTROSE AVE. • CHICAGO 18, ILL.

Distributors in Principal Cities

Cable: HIMCO Chicago

COMPRESSORS • ACCUMULATORS • CONDENSERS
UNIT, BRINE COOLERS • SURGE DRUMS • VESSELS
FIN AND PIPE COILS • FLAKE ICE MAKERS • RECEIVERS

news briefs of the month

Frozen Foods Coordinating Committee Meet

Frozen Foods All-Industry Coordinating Committee held its second meeting in Washington, D.C. in September. All segments of the industry which are members of the committee were represented and in addition the National Food Brokers Association and the Association of American Railroads had observers on hand. Among the important matters dealt with were:

1. The substantial progress being made in the organizations. 2. The first draft of the All-Industry voluntary practices was prepared as a result of committee sessions. 3. The educational program of the committee was reported in full progress. 4. Plans for industrial self-control in the matter of adoption and consistent employment of the Voluntary Operational Practices by individual firms.

Ammonia Prices Are Increased

Due to higher costs the prices of anhydrous ammonia are on the increase. One company has announced increases of one cent a pound for anhydrous ammonia in cylinders in 27 Eastern, Southern and Mid-Western states and the District of Columbia, which becomes effective November 1. In the same announcement the price of tank truck ammonia will be increased one-half cent in 12 states.

Freeze-Dried Foods Need Refrigeration

Freeze-dried foods are definitely on the way. Within the last year several food processors have test-marketed a variety of foods prepared by freeze-drying. The process is emerging from the laboratory stage. With this emergence comes the repeated question "will freeze-dried foods mean a loss in refrigerated warehouse business"? The answer is still "NO". Freeze dehydration process when done properly results in a compact easily restored excellent quality food. However freeze-dried foods are subject to color, flavor and texture changes common to all foods when exposed to ordinary temperatures and refrigeration will be necessary to maintain their good color factors. They won't spoil being unrefrigerated but must be protected from high temperatures in order to maintain good color, flavor, etc.

A New Refrigerated Warehouse in Toronto

A two million cu. ft. refrigerated warehouse will be built in West Toronto by Winnipeg Cold Storage Co. The plant, incorporating some of the latest technological advances, will contain 150,000 sq. ft. of floor space on a five-acre site between Queensway and Queen St. It will cost about $2 million dollars.

First major public cold storage installation to be built in the Toronto area in five years, the new plant will provide atmospheric control as well as low temperatures, according to Leon Chechik, chairman of the board, Winnipeg Cold Storage. The warehouse will handle all food products including sea foods such as frozen lobster from the Maritime Provinces.

Frozen Orange Juice Output Rising

Consumer purchases of frozen orange concentrate is at an all time high and the next season's production must be increased accordingly in order to fulfill the further consumer increases expected. Consumer purchases for the first part of this marketing year are up approximately 31 percent over the corresponding period of last year. Total sales of orange concentrate in the 1950-60 season is expected to amount to more than 83 million gallons. To supply this quantity it was necessary to dip into the beginning of the season's inventory to the extent of about five million gallons.

Front Cover

More than 54 million people in 28 countries throughout the world have seen American refrigeration during the past five years at exhibits staged by the United States at international trade shows, the Office of International Trade Fairs reported recently. "Whenever and wherever the United States goes to an international trade fair," a spokesman for the Office said, "American refrigeration equipment goes along." However, it is the beautiful looking installations such as the Vilter equipment pictured on our front cover, and installed in Italy that will continue to sell more American made refrigerating machines abroad. The equipment includes 4 refrigerant 22, 8 cylinder Vilter VMC compressors. The system was designed and installed by Vilter distributor, Dell'Orto Chieregatti.

Table 1—Periods of Time at Various Temperatures That are Approximately Equivalent in Their Effect on Quality Loss of Frozen Foods

(based on the loss equal to that experienced at 0° F. for 1 year)

Temperature	Sensitive Fruits and Vegetables	Other Fruits and Vegetables	Turkeys and Cut-up Chicken
0° F.	1 year	1 year	1 year
5° F.	5 months	5 months	....
10° F.	6 weeks	2 months	6 months
15° F.	3 weeks	1 month	....
20° F.	1 week	2 weeks	3 months
25° F.	2 days	1 week	....
30° F.	1 day	3 days	....

How To Use Time-Temperature Frozen

»» IT IS generally recognized that freezing offers one of the best means available for capturing the fresh color, flavor and appearance of many foods, particularly fruits and vegetables.

Unfortunately, however, there are many factors which must be carefully considered and controlled if we are to end up with a top quality frozen product. Among these factors are variety, harvest maturity, handling of the product after harvesting, and proper processing and freezing procedures. Deficiencies in any one of these factors is certain to cause an initially frozen product of less than optimum quality. I cannot over-emphasize the fact that quality losses can and do occur during these pre-freezing and freezing operations as well as in the distribution system. Strict maintenance of uniformly low temperatures will only maintain the original quality which was packed into the product. They certainly won't make a good product out of a poor one. Therefore, it is very important to control quality during the pre-freezing and freezing operations as well as controlling temperatures in the distribution system.

A little later on we will discuss the effect of freezing rate alone, but let us return to the effect of various temperatures and temperature sequences on the quality of frozen foods.

Table I, in essence, shows the high quality life of three different categories of frozen foods. Sensitive fruits and vegetables which change most quickly at temperatures above zero are listed in the first column. These changes usually manifest themselves in the form of color or appearance changes, such as occur in frozen peaches, beans and cauliflower.

In the second column, we have what we might consider average fruits and vegetables.

In the third column the poultry products listed are probably the most stable of the three groups at least for temperatures above 0° F. The times listed opposite each of the temperatures, produce the same change that occurs during storage at 0° F for one year. We can consider the times at these different temperatures as representing the high quality life of these products. The important point to notice is, that these times are reduced about one-half to one-third for each 5° F increase in temperature. In other words, time is just as important as temperature in determining how much quality is lost.

For example, products stored 2 months at 10° F are just as good as the same products stored at 0° F for one year. So, if we want to specify a given quality loss, we had better specify time as well as temperature. **(See Question Group I at the end of this article.)**

Figure I popularizes the relationship between rate of deterioration and temperature.

Here we can compare the rate of deterioration in frozen foods to a little cart that is standing on the knoll of a hill. If we released the brakes on this cart, it would just barely begin to move because we are on the flat part of the hill.

This corresponds to storage at 0° F. There is a definite deterioration going on at zero, but at a very, very slow rate.

As we go down the hill, the incline gets steeper and the cart moves faster and faster.

This is very similar to what happens in frozen foods: As the temperature goes up, the rate of deterioration increases several times for each 10 degrees that the temperature rises.

An important point to notice, however, is that the curve stays fairly flat until we get up to around 20° F, and thereafter curves sharply downward.

At zero, we might compare this to a very leisurely pace of walking; at 10 to 15° F, to a very slow trot; at 20° F to traveling on a scooter at 30 to 40 miles an hour; and at 30° F to traveling in a light airplane at 200 to 250 miles an hour.

Both this curve and the date in the previous table show the simple relationships between steady temperatures and either rate of deterioration or the time that it takes to produce a given quality change.

These relationships are fairly simple and straight-forward. However, in actual practice we are hardly ever dealing with such simple steady states, but with constantly changing temperatures.

The problem then is how do we evaluate the irregular temperature histories which are encountered in actual practice.

We have been able to do this by making use of the steady temperature data shown in Table I and Figure I. From this data, we construct a special coordinate system which allows estimation of quality losses arising as a result of any given temperature history.

These losses may be expressed in terms of the total amount of damage done or in terms of days at a given steady temperature that

Tolerance Findings In Your Business of

Food Handling

By DANTE G. GUADAGNI

Mr. Guadagni is associated with The Western Research Regional Laboratory, Albany, California, which is a laboratory of the Western Utilization Research and Development Division, Agricultural Research Service, U.S. Department of Agriculture. His paper, "Frozen Food Handling", was presented at the National Association of Refrigerated Warehouses Annual Meeting in Miami, Florida.

will produce the same damage which has occurred as a result of that particular temperature history.

Now that we've discussed the effects of temperature on rate of quality deterioration, what can be done to minimize the changes which can and do occur when the temperatures are abnormally high?

Obviously, if we maintain 0° F or lower for a reasonable period of time, there is not much improvement that can be made. Possibilities for improvement lie in the area where shipments are received at various temperatures.

It would not be very wise to handle a load of frozen foods that came in at zero to 10° F like one that came in at 20 to 30° F. The first thing we need to know then is what kind of temperature we are dealing with. The next question is what happens to the temperature *during* unloading and standing on the dock while awaiting transfer to the storage room?

There are many factors which influence this, particularly the air temperature on the dock area.

The data in Table 2 was obtained from a single-exposed case on the top corner of a pallet standing in air at 65° F.

It is emphasized that this data pertains only to standing in air at 65° F. Different temperatures will obviously give somewhat different results. These results are based on the average of eight different commodities representing different sizes of cases, shapes, etc.

If we start out at 0° F, in one hour the most exposed case will be up to about 6° F and in two hours about 10° F.

If we start at 10° F, in one hour, on the average, the product will rise 4° to 14° F, and in two hours to 16° F.

Particular note should be made of the times required to bring these products in the neighborhood of 15° F or so. Table 3 shows what this 15-degree level means in terms of the amount of quality loss when this particular case is moved into the center of a pallet and placed in a still air storage room at 0° F.

Table 2—Average Temperature Rise In Top Corner Case of Pallet Standing In Air at 65° F.

Initial	Temperature After:			
Temp. ° F.	½ Hr.	1 Hr.	2 Hr.	4 Hr.
0	4	6	10	16
10	12	14	16	19
15	16	18	20	23

Table 3—Effect of Arrival Temperature on Quality Loss In Center Case-Pallet of Frozen Food

	Percentage of High Quality Loss If:	
Arrival Temp. ° F.	Tightly Stacked In Still Air At 0° F.	Spaced and Blast Frozen —25° F.
25	50	3
20	23	1
15	4	1
10	2	1

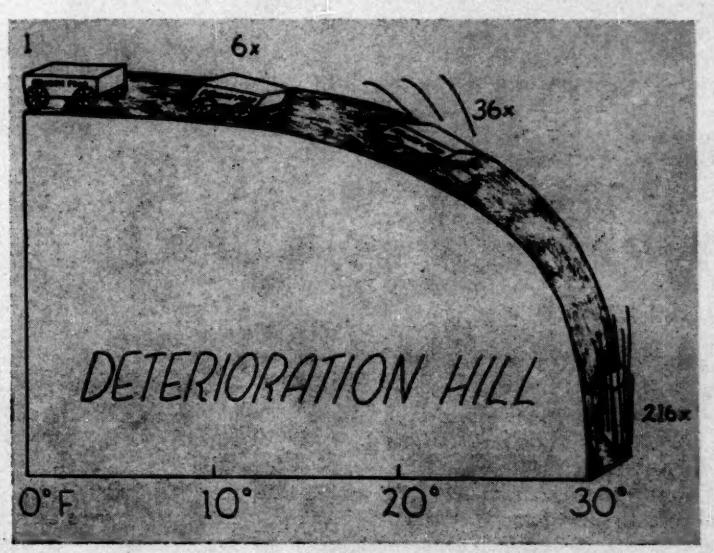


FIG. 1

Table 4—Quality Loss in Commercial Pallet Freezing

Percentage of High Quality Loss During Freezing to 0° F.	Percentage of Plants Tested	
	Fastest Rates	Slowest Rates
0 to 25	0	0
26 to 50	45	18
51 to 75	28	18
76 to 100	18	28
101 to 200	9	36

Table 5—Effect of Pallet Transfer at Various Center Case Temperatures

Temperature ° F.	Percentage High Quality Loss If:	
	Transferred to Still Air at 0° F.	Allowed to Remain in Blast Freezer
30	62	11
25	42	3
20	18	1
15	2	1

If we have 25° F in the center case of a tight stacked pallet at 0° F we will lose about 50 percent of the high quality life of the product, which would be the same as storing that product at 0° F for six months. Since the high quality life of the product is one year at 0° F, a 50 percent loss is equivalent to storing it six months at 0° F.

The advantage of blast freezing at these high temperatures is obvious.

At 15° F, however, we notice a big change in the difference between the two methods of cooling.

The difference between tight stacking in still air and blast freezing has been reduced to an insignificant amount. At 10° F, it is even less. Obviously, then, there is not much advantage to blast freezing a product which has only warmed up to somewhere between 10 and 15° F. **(Question Group 2).**

We have recently concluded a survey of pallet freezing rates on the West Coast. The object of this particular study was to find out what actually happens in commercial pallet freezing operations, in terms of time, temperature and quality changes.

We surveyed a total of eleven commercial plants in California, Oregon and Washington. The goal in each of these plants was to find the range of freezing rates from the best to the poorest. We obtained a total of about 75 different complete freezing rates from these eleven different plants. **(See Question Group 3).**

The fastest single freezing rate we found in the entire survey caused a 26 percent loss in the high quality life of the product.

The slowest single freezing rate caused a 200 percent loss in the high quality life, which simply means this particular freezing operation caused the same amount of damage that occurs during two years' storage at 0° F, 20 days at 20° F, or 120 days at 10° F. The minute that product got down to 0° F, it was really already two years old. **(See Question Group 4).**

Results of this commercial survey indicated that on the average we were losing about 80 percent of the high quality life of the product.

This would be the same as storing the product at 0° F for about nine months.

An average figure does not tell the story too clearly. Table 4 breaks this into the fastest and slowest rates found in each plant, and the percentage of the 11 plants which caused a given range of quality loss.

These freezing operations were causing more than 25 percent loss in the high quality life of the product in every single situation which was encountered.

Using only the fastest rates 45 percent of the plants were causing a 26 to 50 percent loss in high quality life; in 28 percent of the plants, 51 to 75; in 18 percent, 76 to 100, etc.

Going to the slowest rates, the distressing thing to note is that in 36 percent of the plants we were losing 100 to 200 percent of the high quality life, which simply means that we were doing as much damage during freezing as you would get by storing the same product from one to two years at 0° F.

In other words, these products were from one to two years old the minute they got down to 0° F.

Obviously, there are many reasons for the large differences observed in quality loss during freezing. All these plants had different equipment, different procedures, etc. But all of these many and varied reasons can really be boiled down to three simple fundamental factors. These are air temperatures; air velocity, and stacking arrangement of the pallets.

Naturally, the lower the air temperature, the higher the air velocity, and the more and better spacing we have between cases, the faster the freezing rate is going to be.

On the other hand, if we have a tight stacked situation, no matter how low the outside temperature or how fast the velocity is, the cases in the center of the stack are going to end up with a very slow freezing rate.

In actual practice it was always observed that the slowest freezing rates were always found in those plants which removed pallets from the freezing tunnel while the center case temperatures were still at relatively high levels.

Table 5 illustrates what this practice means in terms of quality. If we remove the pallet from the freezing tunnel to still air at 0° F with a center case temperature of 30° F, 62 percent of the high quality life is lost in bringing the product from 30° to 0° F. On the other hand, if it is allowed to remain in the blast freezer at temperatures of —20 to —30° F we would lose only 11 percent of the high quality life.

When the center case temperature is 15° F, however, we have a big drop in quality loss in a tight stack situation in still air at 0° F. The difference between still air and blast freezing for center case

temperatures of 15° F is very minor and insignificant. When these temperatures are reached, it would obviously be better to get the pallet out of the blast and replace it with warmer product. (See Question Group 5).

I would like to conclude with the fact that I have stressed before: These quality changes can and do occur during freezing, before freezing, and after freezing. It really doesn't make any difference when or where they occur. They all add up to one and the same thing: Either a mediocre or poor frozen product. Naturally this does not tend to engender confidence in the consumer of these frozen products. So this whole frozen food picture should probably be taken with both a wide angle and a telephoto lens.

The wide angle to get all the important operations into the total picture and the telephoto lens to bring all these important factors into sharp focus and proper perspective.

QUESTIONS AND ANSWERS ON FROZEN FOOD HANDLING

During the presentation of Mr. Guadagni's paper, the audience was permitted time to ask questions at the point indicated by "(See Question Group 1, 2, 3, etc.)". The following are the questions and answers under corresponding numbers.

Question Group 1

QUESTION: Paul D. Walsh (Chicago, Ill.): As to this Table 1, I would like to ask you if these turkeys had an overwrap of Cryovac? Was there any packaging material on the fruits and vegetables?

ANSWER: Mr. Guadagni: The packaging on turkeys and cut-up chickens was Cryovac. On vegetables, it was the usual paper carton with overwrap. On fruits, it was the composite type of carton with metal ends.

QUESTION: Mr. Walsh: Could you tell us what would happen to turkeys if they did not have any overwrap. Could you tell us what would happen to vegetables if they did not have any overwarp? How much loss in quality would that give us in one year?

ANSWER: Mr. Guadagni: Obviously, if you had no packaging whatsoever, the quality loss, particularly in poultry products, would be very severe. I do not believe anyone would be foolish enough to put these products out without protective packaging. We actually have not gone into the problem of how long you could keep something without any packaging at all. I would guess that, if you had no packaging whatsoever, you would cut the life in half, at least, because you would run into some serious discoloration and desiccation problems in all of these products.

QUESTION: Mr. Walsh: Is it true, if we found a better overwrap for turkeys and vegetables that the quality loss would be less than you show in this table.

ANSWER: Mr. Guadagni: The answer to that, particularly for poultry products, would be yes. But the difficulty is that in order to get maximum protection you would have to pack under nitrogen in a hermetically sealed tin. I think you will agree this would be a rather unorthodox, cumbersome and expensive way of marketing this particular product. In vegetables, I do not believe a more hermetic container would make much difference in shelf life. In fruits, vacuum packaging in hermetic containers would very definitely increase the shelf life.

QUESTION: Paul D. Burrill (Boston, Mass.): Is there any quality loss at 0° F at the end of one year?

ANSWER: Mr. Guadagni: The answer to that, sir, is yes. There is a certain amount of quality loss at the end of one year at 0° F.

QUESTION: Alex MacTaggart (Scranton, Penna.): At what temperature would these products have to be kept to have a negligible or undetectable loss for one year?

ANSWER: Mr. Guadagni: The answer to that would be about −10°.

QUESTION: Ralph Kardett (King Company, Owatonna, Minn.): Is it not true your quality is determined by how fast the product is frozen?

ANSWER: Mr. Guadagni: It most certainly can be determnied by freezing rate.

Question Group 2

QUESTION: Paul D. Burrill (Boston, Mass.): You talk about "Quality loss". How about bacterial counts? At what temperature is that dangerous?

ANSWER: Mr. Guadagni: I purposely have not mentioned bacterial counts because at temperatures of 14 and below there is no problem from bacteria.

Even at 20° F, the bacterial count actually drops rather than increases in many products. While some organisms can grow above 14° F, food poisoning organisms are not a problem below temperatures of 30-40° F.

QUESTION: Mr. Grubbs: I was wondering if anybody in the Department of Agriculture is going to do any research on frozen cooked foods on time temperature.

ANSWER: Mr. Guadagni: We actually have done some work on turkey dinners, turkey pies, and fried chicken. We do have a number of publications on the items I have mentioned, and that information is available.

QUESTION: Mr. Grubbs: Is the rate of deterioration comparable to the vegetables? Is there any different data?

ANSWER: Mr. Guadagni: In fried chicken for example, the rate of deterioration is somewhat comparable to frozen strawberries at temperatures above 0° F. At 0° F, the stability is considerably less. At 0° F 4-6 months seems to be the point where changes begin to show up in fried chicken.

QUESTION: Mr. Kuehn: Would you care to tell us off the record if you are not officially in charge of any of this? I am thinking of things I heard and read about in reference to these prepared foods; primarily, gravies and things of that sort, where the bacteria counts multiply rather rapidly between zero and ten degrees. Am I right

or wrong about that? Not just the gravies, but any other prepared foods that you know of.

ANSWER: Mr. Guadagni: I do not know of any reliable scientific information that indicates rapid bacterial multiplication at temperatures of 0 to 10° F. None of the published information shows anything of this kind.

QUESTION: Edward Joyce (Savannah, Ga.): If bacteria is not causing these changes at zero degrees and higher, what is?

ANSWER: Mr. Guadagni: In most cases, these changes are caused by active enzymes varied and complex chemical compounds, and atmospheric oxygen. If we have excellent packaging, which does not permit the entrance of oxygen, we can minimize the chemical changes, and the enzymatic changes are greatly reduced at lower temperatures.

QUESTION: Mr. Joyce: Does that mean you do have substantial enzymatic changes between zero and ten degrees on prepared foods.

ANSWER: Mr. Guadagni: Most enzymes are destroyed at temperatures of 180 to 190° F for very short times. Therefore, in cooked prepared food you would not normally be concerned with enzymatic changes, but mostly with chemical changes.

Usually, the most labile components in a prepared product are the fats which rancidify in the presence of oxygen.

In raw foods the enzymes play a very important part. The discoloration in frozen peaches is a good example of an enzymatic change.

QUESTION: Mr. Joyce: You then mean there is a chemical change. Is that chemical change substantially between zero and ten degrees? I would just like to button this down.

ANSWER: Mr. Guadagni: At 0° F it will take a year to produce a given change in some of these constituents. At 10° F, it will take two months to produce that same change at the same level, which means that at 10° F this change is going on about six times faster than at 0° F.

In practical terms, even though this rate is six times faster than at zero, it is slow enough so that you have two months at ten degrees before any appreciable change will occur.

Changes are certainly going on so slow at —10° F that it will take several years to notice any appreciable change in the product itself.

Question Group 3

QUESTION: Mr. Newell: In order to clarify that term, would you describe what you mean when you say "Pallet freezing operation?" All of us may not understand it.

ANSWER: That is a very good question. What I mean by "Pallet freezing" is simply this. The situation where the product is packed and cased in the normal manner at room temperature which ran from 65 to 70° F in these particular operations. After casing the product was stacked in a normal pallet, either with or without wood spacers between layers of cases; then, the entire pallet was trucked into a freezing tunnel or a sharp room.

Question Group 4

QUESTION: Mr. Joyce: What do you mean by "quality"? Do you mean in the taste, color, or what?

ANSWER: Mr. Guadagni: Flavor and color. We are dealing with flavor, color, and any quality attribute which will make the product different than it would be if it were stored at a low steady temperature.

Question Group 5

QUESTION: From the Floor: That 15, I can very easily see that the quality loss is negligible. You did not go 16, 17, 18 or 19, did you?

ANSWER: Mr. Guadagni: First of all, let me say that we did not have the opportunity of removing a whole pallet at these different temperature intervals. For each degree that you go up the temperature scale, however, the damage begins to compound itself. In other words, it is not a straight linear relationship. It is a geometric relationship.

QUESTION: From the Floor: What was the product?

ANSWER: Mr. Guadagni: The product in this particular case was strawberries. Incidentally, pallet freezing is mostly confined to fruits.

QUESTION: From the Floor: In each case in each plant, was the time from the processing plant or packaging plant to the freezer relatively the same? How much of this quality loss takes place in delay between packaging plant to freezer? You seem to imply there is no variable there. There must be some.

ANSWER: Mr. Guadagni: Oh, yes. That was all taken into consideration. The longer it stays at 60 to 70, the greater the amount of deterioration. You are really losing quality many, many times faster if you are waiting around to bring this product from the processing section into the cold storage or freezing section.

QUESTION: From the Floor. This project with strawberries, to what extent was the pre-processing history of the fruit taken into consideration?

ANSWER: Mr. Guadagni: Do you mean by that, when it is picked and so forth?

QUESTION: From the Floor: The time from picking to actual processing, and the treatment in that period.

ANSWER: Mr. Guadagni: Actually, in that area we had no information. These studies were conducted in commercial plants with the material that they had available. We do not have any records on the history prior to the processing.

QUESTION: From the Floor: Did you start with the product as it was processed?

ANSWER: Mr. Guadagni: We started with the product the minute it was packaged. The temperature measuring units went into the cases at that particular time. Everything from that time on is considered in determining these quality changes.

Some Economics On

Liquid Nitrogen for Tomorrow's Frozen Foods

»» HOTTEST new prospect in the frozen-food industry today is the use of liquid nitrogen to provide refrigeration both at the processing plant and in transit. The method, studied currently by Union Carbide Corp., Air Reduction Co., Liquid Carbonic Co. and Isbrandtsen's Liquefreeze Co. has already proven its technical soundness. Still to be resolved is the economic attractiveness of liquid nitrogen cooling in competition with established food deep-freeze methods.

Method of operation is simple. Food, taken directly off the processing line, is taken by conveyor through an insulated cabinet containing a pool of liquid nitrogen. Direct heat exchange results in rapid subcooling of the produce (less than five minutes to cool from 180°F. to –5°F.), vaporized nitrogen is withdrawn through vents and recirculated to the liquefaction unit.

Leaving the cooling chamber the produce is conveyed to the packing line and is then taken directly to insulated railroad cars or truck trailers which are also refrigerated by liquid nitrogen.

The process has been demonstrated in Los Angeles in a plant producing 60-120 retail packages per minute, with a cooling time of 2-3 minutes to reach –5°F. This plant has now been purchased by a major East Coast food processor. See page 26, August 1960, Industrial Refrigeration

Key to the economics of the process are method of insulation employed in the cooling chamber, and in the transit cars, and cost of liquid nitrogen. Adequate low-cost means for insulating at the low temperatures involved are at hand in the foamed polystyrene and polyurethane resins which have come on the market during the last 3-4 years.

Even more significant is the cost of liquid nitrogen. Impelled largely by guided missile demands, much progress has been made during recent years in small cryogenic plants; the type which would be used by large food processors to produce their large nitrogen requirements. Economics of liquid nitrogen plants is very sensitive to volume of production. North American Phillips Co. reports that a plant producing 200 liters per week liquid nitrogen will have a 5-year payout at a 30¢ per liter nitrogen price while a weekly volume of 1000 liters yields the same payout at a 10¢ per liter price. (One quart, U. S. = .9463 Liter). Still more favorable economics can be achieved in locations where liquid nitrogen can be obtained as co-product of a nearby oxygen plant.

Most likely method of operation will be to run the almost completely automatic liquefaction plant around the clock, and store liquid nitrogen during periods of downtime in the food processing line.

Limitations

Nitrogen consumption for food refrigeration depends on time and distance of hauling required in-transit temperature, food being handled and effectiveness of car insulation. Liquid Carbonic Co. reports a consumption of 2700 liters nitrogen to freeze a 40 ft. load of frozen juice and ship it in specially insulated trailers from California to New York.

As a rough rule of thumb, Liquefreeze Co. suggests that liquid nitrogen cooling will prove competitive for food processing plants turning out at least 75 retail packages per minute on an eight-hour day. Another minimum capacity mentioned for favorable economics is a daily shipment of ten tons on trips of at least three days' duration. Not all companies in the field are, however, as optimistic about the economic attractiveness of freezing by liquid nitrogen.

While the economics of liquid nitrogen food refrigeration are still in doubt, the technical feasibility has been clearly demonstrated. Almost all foods have been frozen and rethawed by this method with excellent shelf life and taste preservation. Used, among other things, for blanching turkey, freezing prepared foods, cakes, nearly all types of vegetables and fruit, the method has even been demonstrated for freezing strawberries which, under conventional deep-freeze methods, change in appearance and taste.

Advantage

Key to the success of liquid nitrogen freezing of foodstuffs is the exceedingly rapid cooling rate (a few minutes compared with up to 24-hour freezing periods for conventional metohds). As a result of this fast cooling, there is no time for osmotic pressure to build up inside the food cells and burst them.

Further benefit is ascribed to the displacement of oxygen by means of nitrogen. The effectiveness of such oxygen removal in improving shelf life is well established and the principle is used in the packaging of Tropicana frozen orange juice and of Chase & Sanborn pressure-packaged coffee, among others.

On a modest scale, liquid nitrogen freezing is already employed by the U. S. military for shipping foodstuffs from the United States to France, Germany, and to the Azores. Using large insulated containers for this purpose, the method has been under investigation for two years, reportedly results in substantial savings over conventional refrigerated shipping.

For commercial shipment, liquid nitrogen refrigeration is still being tested. For over a year, Lique-

Continued on page 25

Automatic Control

By A. L. TOPP, Vice Pres.
Controls Co. of America
Milwaukee, Wis.

How to Control it —

1—Automatic expansion valves.

2—Pressure limit type thermostatic expansion valves.

3—Evaporator pressure regulators.

4—Suction or crankcase pressure regulators.

5—Head pressure regulators.

6—Pressure sensitive electric controls, such as pressure switches and solenoid valves controlled by pressure switches.

Why Control it —

1—Prevent excessive pressure from damaging equipment.

2—Prevent excessive suction pressures and high load on the compressor motor with consequent overload "kick-out".

3—Hold evaporator at predetermined temperature or to prevent evaporator coil "freeze-up".

4—Maintain head pressure at an efficient level of operation.

5—Prevent head pressure from falling too low as in an air cooled condenser located outdoors.

»» IN RELATION to refrigeration, pressure can be defined as that force exerted by molecules of vapor as they leave the surface of a liquid. The greater the temperature, the greater the pressure. This we call vapor pressure.

If we consider only a group of molecules in a gaseous state, we then say that pressure is the force exerted by the random movement of these molecules. The more we confine, or compress these molecules into close proximity with each other, the greater are the forces involved, and hence the greater is the pressure.

In a refrigeration system, we want to control pressure for the five reasons listed on this page and we control pressure with the six general types of devices listed.

In this discussion we will concentrate on the first five devices mentioned, that is, the non-electric type or the mechanical modulating type of controls.

Consider the particular devices that fit into this mechanical modulating type pressure control group and see briefly how they operate, what their construction is, and how they are applied in various refrigeration circuits.

Automatic Expansion Valve

The first of the group is the automatic expansion valve which was one of the early types of controls to make its appearance on the refrigeration control frontier. It is basically a pressure reducer. It is sensitive to its outlet pressure and opens on decline of outlet pressure below a pre-set opening point. Fig. 1 shows a cross section of a typical automatic expansion valve. Note diaphragm and valve orifice. The diaphragm feels the valve outlet pressure. The inlet pressure has virtually no effect on the opening of the valve.

Fig. 2 shows a simple refrigeration circuit employing an automatic expansion valve. The automatic expansion valve tends to hold the evaporator pressure constant while the compressor is running.

The basic limitation, of course, is that this control does not adapt itself to changes in heat load, but serves only the objective of holding the pressure from going above a pre-set level.

The thermostatic expansion valve (TXV) was evolved as a next refinement over the automatic expansion valve. This device adapts itself to changes in heat load and keeps the evaporator supplied with sufficient liquid refrigerant so that the superheat at the outlet of the evaporator will always be held essentially constant.

A refinement in the make-up of a thermostatic expansion valve is the inclusion of a "pressure limit" feature. This "pressure limit" serves the purpose of limiting the evaporator pressure to a pre-set maximum and hence preventing motor overload.

This "pressure limit" feature in a TXV is accomplished by two methods:

1 – mechanical method.
2 – gas charging method.

Mechanical Type Pressure Limiting

Fig. 3 shows a typical TXV with mechanical pressure limit.

This valve employs a "liquid" charge and may be installed in any location, for example, the body may be colder than the head. Note the two metal diaphragms instead of one as in ordinary TXV's.

During normal operation the upper diaphragm is held down in a fixed position by the upper (pressure limit) spring. This diaphragm then has no effect on the operation of the valve. The lower diaphragm, however, operates as in a normal expansion valve and modulates in such a manner as to maintain a constant superheat at the outlet of the coil.

Under conditions of high heat load on the evaporator, the evaporator pressure, and also evaporator temperature, will tend to rise. The thermal bulb will sense this warmer temperature and cause the TXV charge pressure to build up in the area between the two diaphragms. This increased pressure will cause the two diaphragms to move apart, and in effect become locked to-

gether and act as a single unit. This causes the control to act essentially like an automatic expansion valve which was discussed previously.

Thus, as the evaporator pressure rises above a preset point, as determined by the upper pressure limit spring setting, the two diaphragms move upward as a unit and tend to close off the valve to prevent further pressure rise.

Hence, evaporator pressure limitation is accomplished and the necessary motor overload protection is achieved.

Fig. 4 shows this particular control employed in a refrigeration circuit. It is a conventional circuit —modified only to the extent of including a TXV with the two diaphragm arrangement to mechanically limit pressure.

Gas Charge Type Pressure Limiting

In this case, evaporator pressure limiting is accomplished by charging the thermal element of a TXV with only a few drops of charge. Fig. 5 shows the pressure temperature characteristic of the thermal charge in this type of TXV.

Under normal operating conditions the few drops of charge will exert vapor pressures corresponding to the saturation temperature of the charge and will cause the TXV to open normally to maintain the desired superheat at the outlet of the evaporator. Should an overload condition arise the evaporator pressure will tend to rise and so will the temperature of the TXV bulb.

As the TXV bulb temperature rises the few drops of liquid charge will exert continually greater pressure until the liquid has completely vaporized. From this point on, as the temperature increases, there will be no further substantial increase in pressure and hence the TXV will not open further. This point at which all of the liquid has vaporized is known as the "evaporator pressure limit point." Again the necessary motor overload protection is achieved.

There is one cautionary note that should be added concerning gas charged TXV's. The bulb of such a TXV must always be colder than the head so that the few drops of charge will remain condensed in the bulb and give proper operation under normal conditions. Should the head of the TXV become the coldest point the few drops of charge would condense in the head and proper control of superheat would be lost.

Evaporator Pressure Regulator

A "so-called" evaporator pressure regulator is a device that is mainly sensitive to its inlet pressure. It closes on pressure decline and opens on pressure rise.

Figs. 6, 7 and 8 show typical devices that fall into this class of controls called "evaporator pressure regulators".

Note that the diaphragm in Fig. 6 feels the inlet pressure and that increase in this pressure causes the valve to open, decrease in pressure causes the valve to close.

The device in Fig. 7 incorporates a metal bellows instead of a metal diaphragm. It is an extremely sensitive device for somewhat critical applications. This device was developed for a soda fountain unit.

Fig. 8 shows an evaporator pressure regulator applied to a typical two temperature refrigeration circuit.

The evaporator pressure regulator holds the pressure up in one

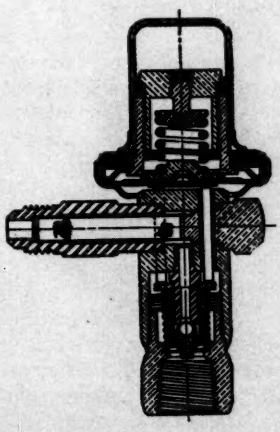


Fig. 1--Automatic expansion valve.

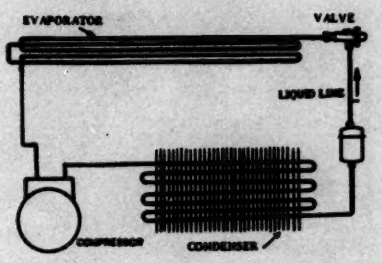


Fig. 2—How the automatic expansion valve is used in a system.

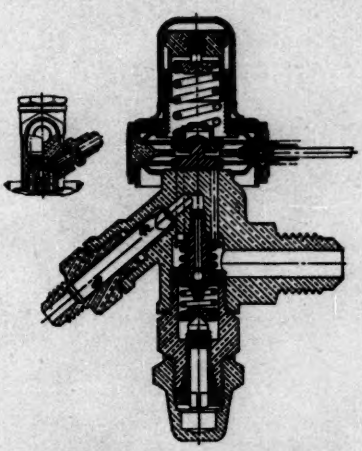


Fig. 3—Thermostatic expansion valve with mechanical pressure limit.

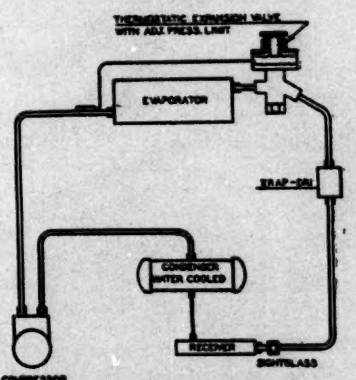


Fig. 4—Conventional refrigeration circuit using mechanical pressure limit TXV.

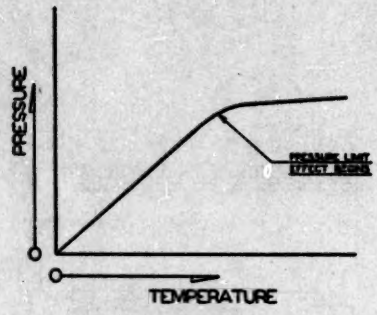


Fig. 5—Pressure-temperature characteristics of thermostatic expansion valve with pressure limiting charge.

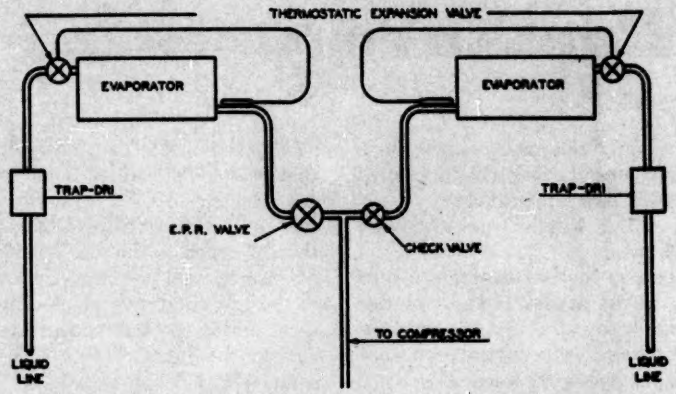


Fig. 8—Schematic view of two-temperature refrigeration system employing an evaporator pressure regulator and a check valve.

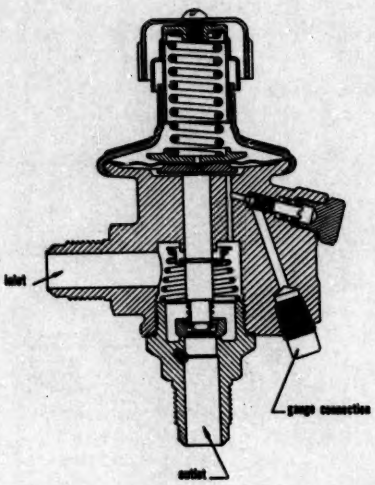


Fig. 6—Evaporator pressure regulator —diaphragm type.

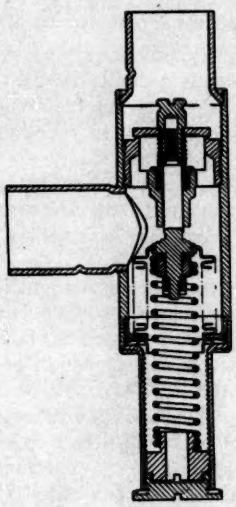


Fig. 9—Crankcase pressure regulating valve for motor overload protection.

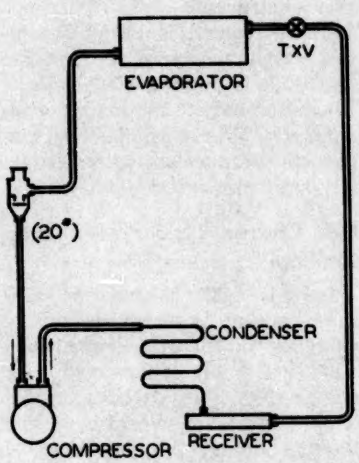


Fig. 10—Crankcase pressure regulating valve in conventional system.

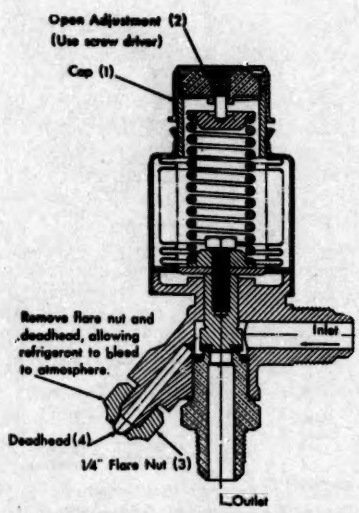


Fig. 7—Evaporator pressure regulator —bellows type.

evaporator. As the pressure tends to pull down below the pre-set operating point, the diaphragm moves downward and tends to close off the valve.

By setting the valve for a pressure which corresponds to a refrigerant saturation temperature above the freezing point of water, for example, ice will be prevented from forming on the coil.

The check valve prevents refrigerant from flowing from the warmer to the colder coil during the "off cycle".

Crankcase Pressure Regulator

The device which is commonly called a suction or crankcase pressure regulator is a device very similar in operation to an evaporator pressure regulator. However, this device is mainly sensitive to its outlet pressure. (The evaporator pressure regulator is sensitive to inlet pressure). The suction pressure regulator opens when its outlet pressure declines. (The evaporator pressure regulator opens when its inlet pressure rises).

Fig. 9 shows a cross-section view of a typical suction pressure regulator. Note that in this case, the inlet pressure is applied to the metal bellows. The area of the orifice is practically equal to that of the effective area of the metal bellows. These two forces oppose each other and in effect cancel each other. Hence the valve actually operates practically independent of inlet pressure and moves instead in proportion to the outlet pressure. As the outlet pressure rises the valve closes and vice versa.

Turn to page 22

B.A.C.

COOLING TOWERS
EVAP. CONDENSERS

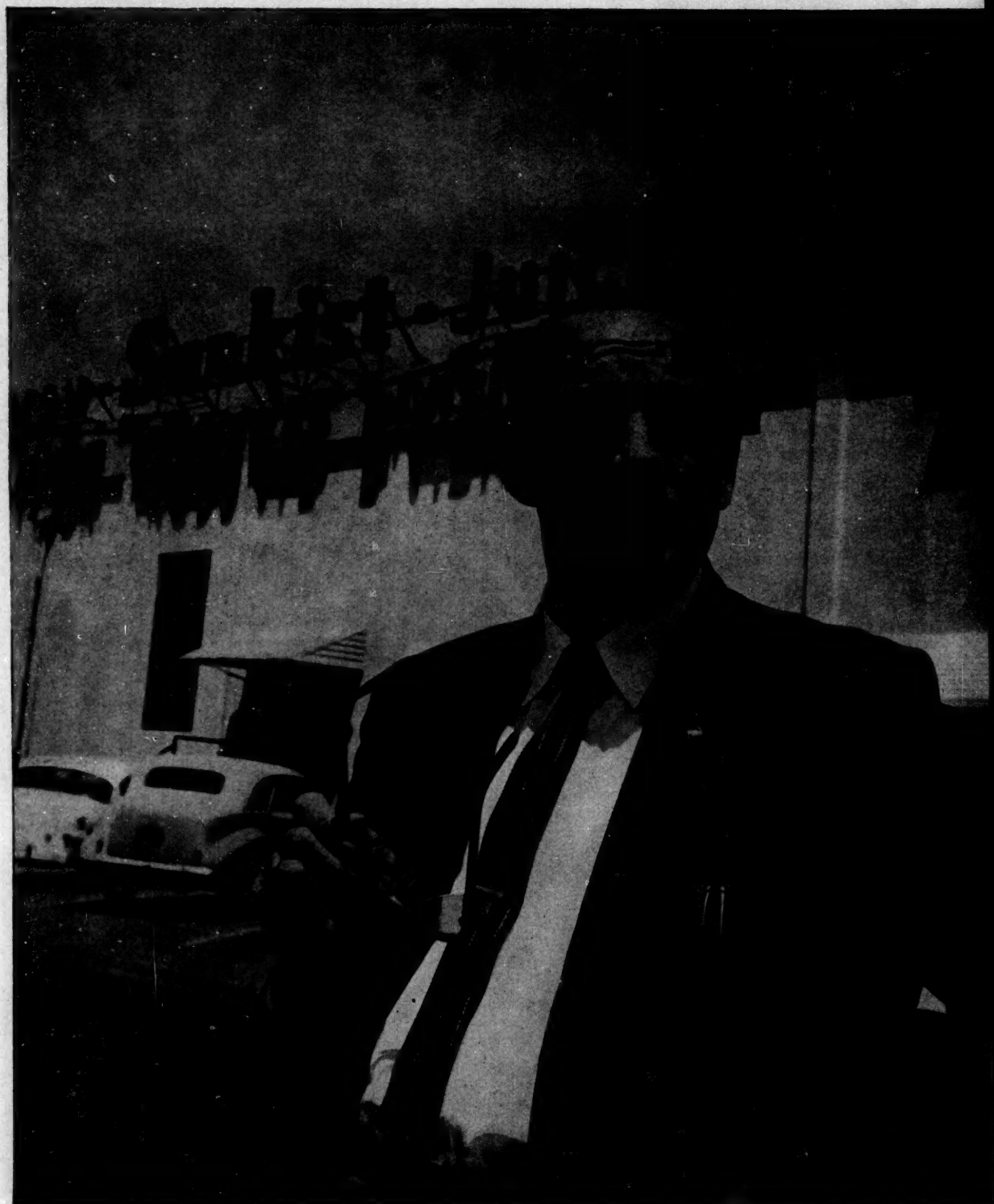
NOW TO 800 *TONS*

in single factory-assembled units

BOOTH R334
DAIRY SHOW
CHICAGO, ILL.
OCT. 31-NOV. 5

Baltimore Aircoil Company, Inc.

DOW | INSULATION



James S. Hutchison, chief engineer for Lemon Products Division, Sunkist Growers, who utilized nearly 400,000 board-feet of Styrofoam in a new warehouse at Corona, California.

STYROFOAM®

Approved Insulation Contractor relieves Sunkist of detail on low-temp installation for new warehouse

"Styrofoam*, installed by a Dow Approved Insulation Contractor," reports James S. Hutchison, chief engineer for the Lemon Products Division, Sunkist Growers, "gives us the advantages of a permanent, moisture-sealed, maintenance-free insulation job." The AIC, Los Angeles Cork Company, installed nearly 400,000 board-feet of Styrofoam in a new warehouse that's so large it can hold enough frozen concentrate to make a four-ounce glass of lemonade for every U.S. citizen.

"Having an AIC do the job meant that we didn't have to spend expensive engineering time to 'nursemaid' the project," Mr. Hutchison points out. "Then too, the inspectors which Dow provided undoubtedly were much more familiar with this type of construction than we. In short, we were relieved of maintaining a time-consuming, laborious inspection program, without risking any defects in workmanship."

As Sunkist found out from first-hand testing, neither water nor water vapor penetrates Styrofoam, which makes its high insulating efficiency (low "K" factor) *permanent*. "Competitive insulating materials were checked for their resistance to vapor passage," Mr. Hutchison reports. "We couldn't even get a pressure drop through the Styrofoam."

As Sunkist discovered by careful investigation of insulation materials and contractors, the AIC certificate is awarded by Dow only to carefully selected contractors capable of providing technical design assistance, followed by expert installation. Los Angeles Cork Company is typical of more than 90 Approved Insulation Contractors located throughout the country. For the names of the ones nearest you, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department 1642BU10.

Dow's registered trademark for its expanded polystyrene

See "The Dow Hour of Great Mysteries" on TV

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

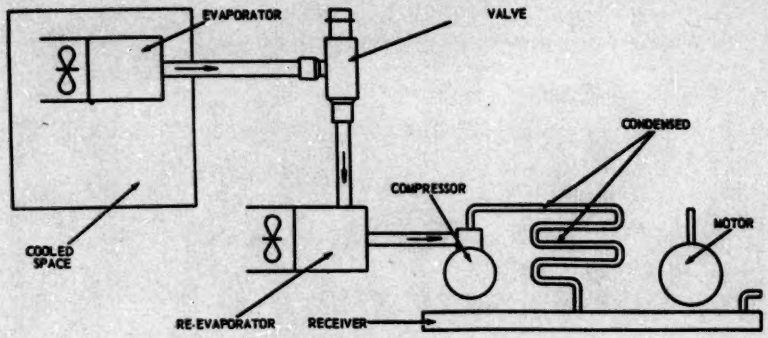


Fig. 11—Hot gas defrost system using pressure regulating valve to protect compressor from overloads.

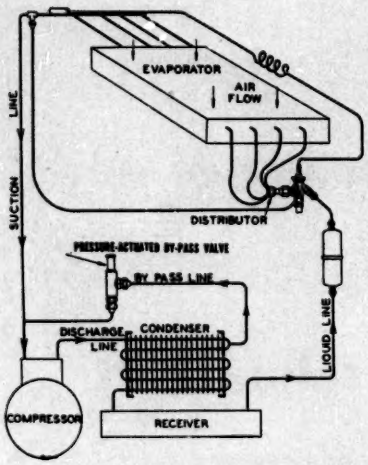


Fig. 12—Pressure regulating valve used as a by-pass valve in capacity modulating control.

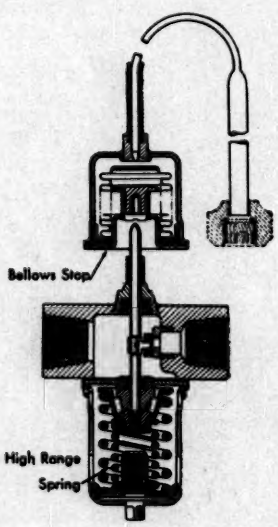


Fig. 13—Water regulating valve.

Fig. 10 shows a conventional application for providing motor overload protection. Note that the valve is located at the outlet of the evaporator, and as mentioned just previously, the device will control the outlet or suction pressure but will have no control over the inlet or evaporator pressure. The control will not allow the suction or compressor pressure to go above its preset value and hence in case of a heavy heat load condition, the necessary motor overload protection is provided.

Fig. 11 shows a circuit employing hot gas defrost. In this case suction pressure limitation is especially important since the routing of hot gas into the evaporator is likely to cause a motor overload condition. The illustration does not show the hot gas line connection between the compressor discharge and the evaporator. It does show the inclusion of a re-evaporator which is used to flash-off liquid that may condense in the evaporator during the defrosting process. Hence liquid is prevented from slugging back to the compressor. The inclusion of the suction pressure control, of course, prevents motor overload.

It is pertinent at this stage to make a comparison between the motor overload protection which is provided by a pressure limit type expansion valve and that provided by a suction pressure regulator.

The means are essentially the same except for two significant differences. First, the suction pressure control is a supplementary control to the TXV and hence, of course, the cost involves that of two controls. The second is, the suction pressure control provides advantage over the pressure limit type TXV.

This advantage is useful in the following situation.

Imagine the situation when a manual defrosting process or a hot gas defrosting process of an evaporator is at the point of completion.

The evaporator is relatively warm and the evaporator probably has an appreciable amount of warm liquid refrigerant in its coils.

Consider what happens when normal operation of the refrigeration system is resumed. The warm liquid in the evaporator will begin boiling off violently, and the stored heat in the evaporator plus the applied heat load (whatever it may be) may very likely cause an overload condition on the compressor motor.

In this case, a pressure limit type TXV would be ineffective in limiting the pressure since the valve has no control over the refrigerant which has already entered the evaporator.

Should the circuit be equipped with an ordinary TXV and a suction pressure regulator, however, we would still have motor overload protection. The suction pressure control, being located at the outlet of the evaporator would throttle and gradually feed the accumulated refrigerant to the compressor. Hence, motor overload protection would be provided despite the presence of warm liquid refrigerant in the evaporator.

In addition to the conventional application of the so-called suction pressure regulator, there are various other uses for this type of control.

One of these uses is that of compressor capacity control or "capacity modulation".

Fig. 12 illustrates this type of circuit. Note that the pressure control in effect is located across the compressor from the high to the low side except for the inclusion of part of the condenser.

Consider again that this control is sensitive to outlet pressure and opens on pressure decline below the pre-set point.

What does this type of operation mean in this circuit?

Imagine that the control is set to open at 35 "pounds". Should the evaporator have very little load on it the compressor would tend to

pull the evaporator pressure down to a low level. However, in the process of pulldown when the 35 pound point was reached the pressure control would open and by-pass the compressor and so limit the useful capacity of the compressor.

When a high heat load would again be applied to the evaporator, the pressure would rise above 35 pounds, the pressure control would return to its closed position and have no capacity control effect on the circuit so long as the evaporator pressure remained above 35 "pounds".

(Note: Part of the condenser is included in the by-pass circuit to provide some cooling effect to the by-passed gas. This is especially necessary when the by-pass valve is open quite far as under low load condition. Under this condition much hot gas is being re-circulated and the gas tends to become highly heated).

You might wonder why an evaporator pressure regulator in series with the evaporator (as discussed previously, in a two temperature evaporator circuit) could not be used in this type of single evaporator circuit to hold the pressure up.

The reason, this is not practical, is because of a condition which occurs in this type of circuit under low heat load conditions. Under this condition the EPR valve would throttle, and with the compressor running continually, the suction pressure would be pulled into a deep vacuum. This deep vacuum may cause the oil in the crankcase of the compressor to foam seriously and be thrown into the high side.

Controlling Condenser or High Side Pressure

The basic device for controlling the head pressure of a water cooled condenser unit is the water regulating valve.

Fig. 13 shows the cross section view of a typical condenser water regulating valve. Note that the force applied by pressure on the exterior side of the metal bellows is opposed by spring force. As the bellows pressure exceeds the preset spring force the valve opens.

A typical circuit application is the conventional refrigeration circuit. This is shown in Fig. 14. The head pressure is applied to the bellows of the water valve. As the head pressures rises above the preset opening point of the valve, the valve opens and allows water to feed through and cool the condenser. As the head pressure declines the reverse action takes place. The particular pressure setting selected should be that which is compatible with the temperature of water which is available, the cost of the water and the cost of electrical power.

Note: The water valve is usually connected to the water inlet line of the condenser. This is probably more desirable than placing the valve at the outlet of the condenser. The reasons are:

1 – On the "off" cycle the condenser is free of water and minerals in the water during the "off" periods do not deposit on the walls of the condenser.

2 – During the "on" cycle, it is more desirable to have the water valve subject to cold water than to hot water as it would be if the valve were located on the outlet of the condenser. This is due to the fact that hot water has more tendency to deposit out minerals than does cold water.

Note: The water valve bellows pressure tap is usually connected directly to the compressor discharge. The particular location of this tap in the high side is usually not a critical matter.

We can apply controls to accomplish certain aspects of head pressure control of an air cooled unit.

The need for some type of control arises when we consider an air cooled condensing unit which is located outdoors or in an unheated area.

In the winter time when the outdoor temperature drops to low levels the condensing temperature will likewise be very low. This then may result in a head pressure which is so low that it prevents proper circulation of refrigerant in the refrigeration system.

Therefore, there is a need for a device that will hold the condensed refrigerant temperature and pressure to a sufficiently high level to maintain the refrigeration system in proper operation under these adverse conditions. The pressure controls which fit into the group called "suction pressure regulators" can be put to use to accomplish this.

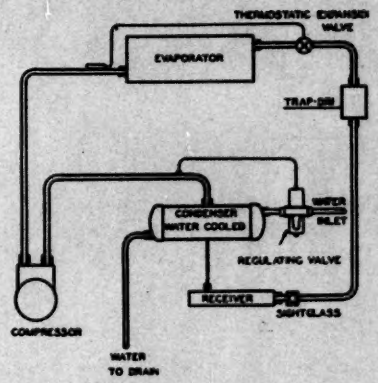


Fig. 14—Water regulating valve in conventional system.

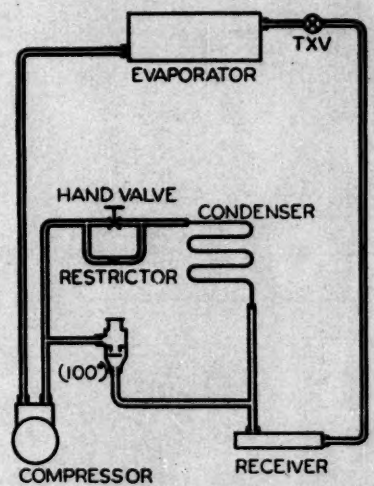


Fig. 15—Pressure regulating valve as used to control air cooled condenser pressures during cold weather.

Fig. 15 shows the so-called "suction pressure regulator" installed in the circuit as a by-pass to the condenser. Remember that this control is sensitive to its outlet pressure. Consider that it is set to open at 100 pounds as indicated in Fig. 15. During normal operation, if we imagine the head pressure is running at 150 pounds, the pressure control will remain closed. However, during extremely cold weather, if the high side pressure at the receiver should tend to drop below 100 pounds, the pressure control would open so as to by-pass the condenser. This would mean that hot gas pressure directly from the compressor would be applied to the liquid in the receiver, and liquid refrigerant would be forced to the expansion valve as under normal operating conditions.

The purpose of the restrictor

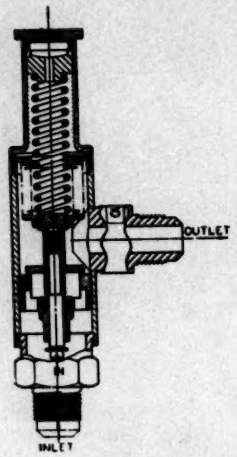


Fig. 16—Type of pressure regulating valve used to maintain condenser pressure.

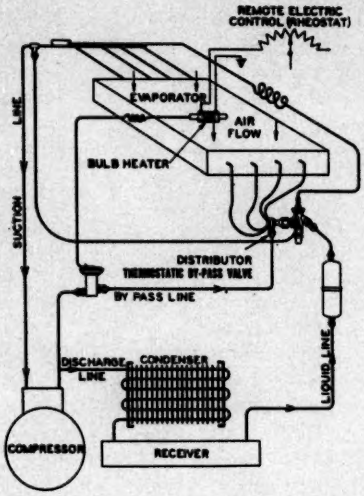


Fig. 19—Thermostatic by-pass control with remote electric control.

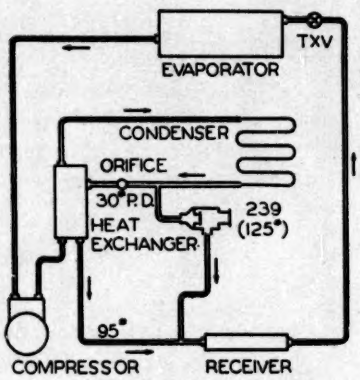


Fig. 17—Head pressure controls used in Pressure Stabilizer.

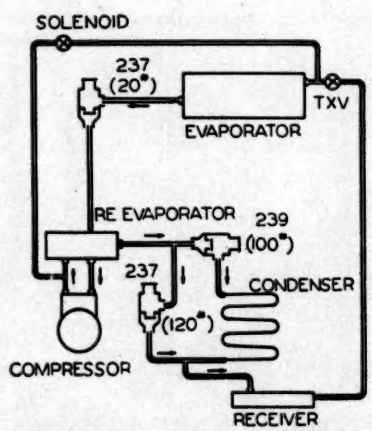


Fig. 18—Hot gas defrost and winter control of head pressure combined.

orifice shown in Fig. 15, is to introduce sufficient resistance to gas flow in the condenser leg of the circuit so that enough gas will pass through the pressure control by-pass leg to adequately build up the pressure on the liquid in the receiver.

The hand valve shown in the circuit should be left open during the warm seasons of the year since no gas by-passing through the pressure control should be required.

During the cold seasons of the year, the hand valve should be closed so that when called into operation in severely cold weather, the restrictor orifice is effective in forcing an appreciable amount of gas through the by-pass circuit.

Another pressure control that will serve the purpose of holding up the high side pressure during wintertime operation is shown in cross section in Fig. 16.

This device is similar in operation to the so called "evaporator pressure regulator" mentioned earlier. The difference lies mainly in the operating range and the pressure change required to bring the valve to full opening. Note that the control is sensitive to its inlet pressure. It closes on pressure decline and opens on pressure rise.

Fig. 17 shows a circuit which employs this type of control to hold the head pressure up during winter time operation.

This control is connected in series with the condenser and in parallel to a restrictor orifice and a leg of a heat exchanger.

Let us assume the control is set to open at 125 pounds as indicated in Fig. 17. Under normal operating conditions, for example, 150 pounds head pressure, the control will be open and the heat exchanger and orifice are by-passed by the pressure control. The orifice restriction assures that very little gas will pass through the heat exchanger leg of the circuit during this condition. This is due to the fact that the pressure control leg of the circuit will offer the lesser resistance to gas flow.

Should wintertime temperature conditions cause the condenser pressure, as felt by the inlet of the pressure control, to drop below 125 pounds, the control will close off and force the condensed liquid to pass through the heat exchanger. Here the liquid will pick up heat from the gas which is being discharged directly from the compressor and its vapor pressure will be raised to the point of maintaining the refrigeration system in proper operation.

An interesting circuit which includes hot gas defrosting, suction pressure limiting to prevent motor overload, and a head pressure control circuit for wintertime operation is shown in Fig. 18.

First note the hot gas line connection between the compressor discharge and the inlet of the evaporator. The valve, labeled 237, in the suction line is a suction pressure regulator to prevent motor overload.

The pressure controls in the condenser circuit serve the following purposes:

The control (239) is in series with the condenser. This control opens when its inlet pressure rises above its opening point. Let us assume this control is set to open at 100 pounds. Then as long as the head pressure remains above 100 pounds this control will remain open and have no appreciable effect on the circuit.

Note: This control takes the place of the restrictor orifice which was in series with the condenser in Fig. 15.

The control (237) is connected in parallel with the condenser. This pressure control is sensitive to its outlet pressure and opens when

the receiver pressure falls below its opening point setting.

Imagine that this control is set to open at 120 pounds. As long as the receiver pressure remains above 120 pounds this control will remain closed and have no effect on the circuit.

Now let us consider what happens when the outside temperature drops and the receiver pressure drops to a low value and causes the refrigeration system to operate improperly.

When the receiver pressure drops below 120 pounds the control labeled 237 opens and allows the condenser to be by-passed.

Secondly as the compressor discharge pressure drops to below 100 pounds the control labeled 239 will close and hence divert all the gas through the control 237. This will cause the compressor discharge gas to be completely by-passed around the condenser, and hold the pressure in the receiver up.

The re-evaporator serves the purpose of flashing-off any liquid that may get into the suction line and hence prevents liquid from getting back to the compressor.

Another interesting circuit, which involves a control not strictly a pressure control is shown in Fig. 19. This circuit includes a by-pass circuit to reduce the effective capacity of the compressor. Note that the by-pass valve is connected from the discharge of the compressor to the inlet of the distributor.

The bulb of the control senses the temperature of the air passing over the evaporator. The control is so constructed that, as its bulb temperature decreases below its preset opening point, the valve opens.

Hence when the air temperature tends to pull down, the by-pass valve opens and reduces the effective capacity of the compressor. As the air temperature rises, as under high load conditions, the valve closes off and will no longer by-pass the compressor. Hence capacity modulation is achieved.

A further refinement in this control is also noted in Fig. 19. Around the bulb is wound a small heater coil. The heater is connected to an electrical source and is in series with a rheostat. The rheostat is for the purpose of varying the amount of heat delivered by the heater. This variable heater serves the purpose of changing the "effective" setting of the control and is in reality a temperature selector. The control bulb will feel a temperature which is a combination of the air temperature and the heater temperature. The air temperature will always be required to counteract the effect of the heater.

Imagine a situation where it is desired to lower the air temperature below a previous level. In this case the rheostat would be set so as to cause the heater to deliver more heat. Hence the air temperature would have to drop to a lower level to counteract the increased amount of heat delivered by the heater.

This in effect changes the "effective" setting of the control without making it necessary to adjust the spring force in the mechanism of the control.

Liquid Nitrogen For Frozen Foods

Continued from page 15

freeze Co. has been shipping all imaginable types of food over most of the United States using two 40-foot truck trailers and one converted ice-and-salt railroad car and expects to have a new railroad car constructed in which foamed plastic insulation boards replace the steel conventionally employed for walls, floor, and roof.

In the construction of these cars, a main problem to overcome is the thermal contraction exhibited by all insulating materials when cooled to –320°F., the boiling point of nitrogen. One solution approved by railroad engineers of Pacific Fruit Express Co. for structural soundness, has been the use of insulation boards which are loaded by external springs to take up thermal contraction and to hold the panels together during heaving of the cars. Typical panel thickness is six inches on ends and sides, eight inches on ceiling and floors. A well is provided in the car bottom to hold a pool of liquid nitrogen which is gradually evaporated in the course of shipment, thus gives up its cooling effect to the car and its contents.

In one recent test run, a car containing 61,000 lbs. frozen vegetables was shipped the 3000-mile distance from California to New York, arrived with an average temperature of –124°F. For future commercial runs, higher arrival temperatures are anticipated, thus calling for reduced consumption of liquid nitrogen.

For the food processor, liquid nitrogen refrigeration is a development worth watching. If economics live up to the optimists' expectation, it will become a means for expanding the line of frozen foods, simplifying food processing operations, and for extending the competitive shipping range of food processing plants.

Epoxy Resin For Making Permanent Pipe Patch

»» A NEW method of pipe repair, which takes a minimum amount of time, has been developed by Minnesota Mining and Manufacturing Co. Offering the advantages of thermosetting epoxy resins, the pipe repair system can be used on any diameter pipe operating at pressures up to 100 psi, the manufacturer states.

Although developed primarily as a safe, reliable means of repairing gas transmission and distribution lines without the use of open flame and without entirely removing the line from service, this technique can be used for liquid piping repairs. The epoxy used is "Scotchcast" brand electrical resin No. 4. This resin is not affected by gasoline, fuel oil, crude oil or other hydrocarbons, and it resists most chemicals. Practical operating temperatures of the resin are limited by extremes of pressure and by increased corrosive action at higher temperatures. However, the epoxy, itself, will withstand continuous operating temperatures in excess of 200 degrees F.

Application techniques employ a pressure hand gun to force the epoxy fluid into a simple tape mold, through a specially designed injection fitting.

New Products Designed to Improve Operation

Portable Temperature Indicator

A 2-LB., battery powered portable temperature indicator has many applications for steam-generating plants, consulting engineers, and general industry. Developed by Fenwal Incorporated, the unit has thermistor sensing probes and bat-

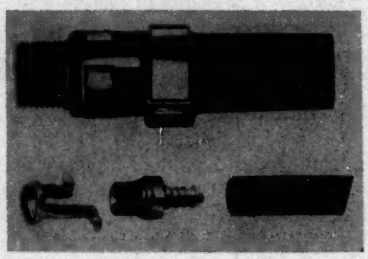
teries having an estimated life of several thousand hours. It is available in ten different ranges, spanning –30 to 350°F, and uses interchangeable probes for air, liquid and surface temperature sensing. Indicators are priced at $59.50 and probes at $35.00, f.o.b., Ashland, Mass.

The Indicator, Model 583, has already found many industrial applications. Utilities use it for periodic checks of incoming water temperature. It is adaptable for periodic checks of processes and equipment, and for surveying plant thermal conditions.

Hose Couplings

A NEW concept in hose couplings is announced by Band-It Company. The new hose coupling assembly is called the Band-It "Piggyback" Tri-Lokt hose nipple and is now available in 1/4"–3/8"–1/2"–3/4"–and 1" I.D. It will fit any hose o.d. or wall thickness regardless of the hose construction or type of service.

The hose nipple assembly may be used for hydraulic hose, double braid and single braid; steam hose and all types of hose which require a positive lock to the hose nipple. It is an all-purpose, reusable hose nipple employing a specially designed stem to minimize abrasion within the hose. It locks in three places in addition to the familiar clamp and nipple methods now in use.



The Band-It "Piggyback" Tri-Lokt assembly consists of one hose nipple and one yoke. Yoke is locked by two Band-It Jr. stainless steel clamps, one placed on top of the other "piggyback" fashion. In addition, nipple is held permanently and uniformly in place by the yoke tie-ends and at the third locking point by the anchoring force of the yoke upon the nipple.

The Band-It "Piggyback" Tri-Lokt assembly when used with wire braid hose is applied directly to the hose with no further preparation than cutting the end of the hose "square". The hose cover is not removed nor is the inside diameter trimmed.

The five sizes of Band-It "Piggyback" Tri-Lokt nipples, (1/4"–3/8"–1/2"–3/4"–and 1") eliminate need for multiple stocks of different types and styles of other couplings. This reduces inventories, for only one size is required for each hose I.D. regardless of hose O.D.

Liquid Level Indicator

A LIQUID level indicator that does not depend upon capacitance or capacitors has been developed by the Electronics Department of Hamilton Standard. It can be used to measure lubricants and other liquids on a wide range of processing equipment.

The elimination of capacitors, which possess limited tolerance for high temperatures and vibration, enables the indicator to operate reliably under severe conditions. Its main components, an electronic control and a unique sensing element which are combined as a single unit, can be engine-mounted and installed where heat and vibration prevent the use of conventional indicators.

The sensing element of the unit will perform with a variety of liquids including those for which capacitive, photo-electric, and mechanical sensors are unsuitable. Response time is adjustable, and a special design feature prevents false readings in the event a sensing element is briefly uncovered. In normal operation, the indicator remains off until the liquid level drops to a predetermined point when it flashes or sounds a warning. The circuit can be checked at any time with a press-to-test button. If desired, the indicator can be installed with its sensor and controls in separate locations.

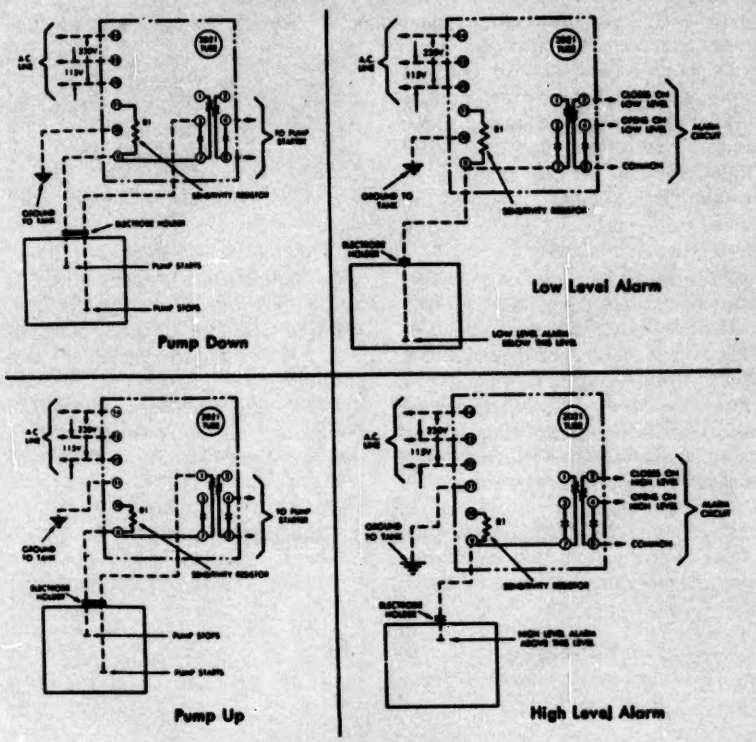
Instrument Valves

A NEW line of Tufline instrument plug valves featuring Teflon sleeves has been introduced by Continental Manufacturing Co.

Rated for 300 lb. ASA service, the valves, which have screwed ends, are available in sizes 1/4" through 1". They are especially recommended for on-off use on rated pressures within temperatures from –50°F to +400°F, with

Electronic Floatless Liquid Level Control

DIRECT OPERATION



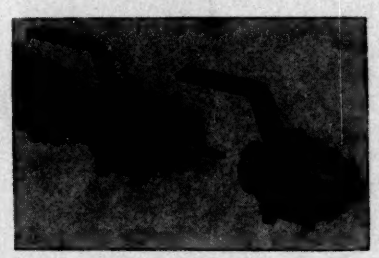
INVERSE OPERATION

A NEW high sensitivity electronic floatless level control developed primarily for use of applications involving liquids of medium to high specific resistance—up to 12.5 megohms—is being produced by The B/W Controller Corp.

Designated Type 50-201, the new control is said to incorporate several design features which make it readily adaptable to an extended range of installations.

As shown by the accompanying diagrams, positive fail-safe operation is assured by wiring to the terminals for either direct or inverse operation. Sensitivity is determined by the value of the fixed resistor mounted on the terminal strip—and selection of proper resistor is based upon the specific resistance of the liquid to be controlled. Typical of those materials on which the control has been used during a 3-year field test program are ordinary and deionized water, alcohol, glycols and anhydrous ammonia—as well as various bulk materials having low moisture content.

In addition, the new control unit's low electrode potential—9 volts d-c.—and low electrode current of less than 1 milliampere eliminate all shock and sparking hazards. Operating characteristics are such that there is no possibility of product contamination due to electrolysis. And, for long distance applications, the system can be operated over leased telephone lines or other lead wires with the control unit located several miles away from the electrodes.



gas or liquid, corrosive or non-corrosive media.

Chief feature of the new Tufline instrument valves is their highly simplified design which brings to the user a construction previously available only in more expensive valves—at a cost so priced that the valves can be economically used within the 150 lb. service range as well as the 300 lb.

Because all moving parts in the valves are supported by low-friction Teflon, no lubrication is required. Consequently, all possibility of product contamination, seizing or galling is eliminated.

Other features include trouble-free operation, minimum maintenance expense, quick visual operation with thru-flow, and easy turning. For example, the 1/2" valve has a torque of 20 inch pounds, while the torque of the 1" valve is only 40 inch pounds.

The new valves are available in standard 303 and 316 S.S. They may also be ordered in other metals, with special ends, or modified for panel mounting.

Specification sheets and additional information on the new line of Tufline instrument plug valves may be obtained.

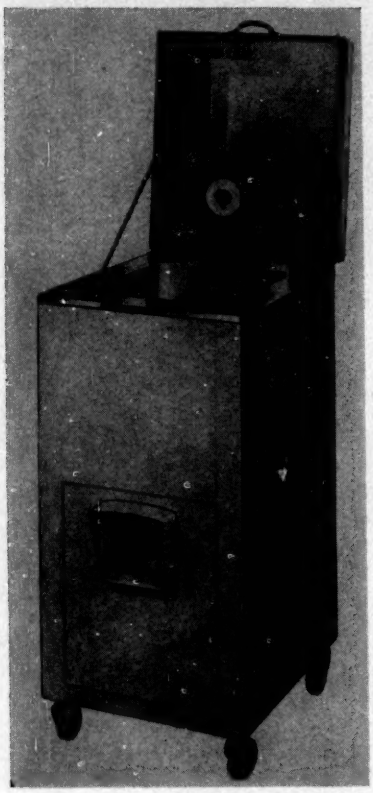
Hi-Low Temperature Test Cabinets

MOBILE environmental test chambers that roll right to the job have been introduced by Hudson Bay Co., Chicago.

Called Hi-Lo "Tempmobiles," the units come in three sizes, and

temperature ranges from –22°F to plus 160°F. All temperatures are thermostatically controlled.

The interiors are 18-8 stainless steel with 3″ of cork and Fiberglas



insulation all around. Formica breakers isolate the interior so there is no frost "carry-through." Interior capacities range from 10 gallons to 50 gallons.

The hermetically-sealed compressor is spring mounted and refrigerant lines have vibration eliminators. The centrifugal type pump has all bronze moving parts.

The environmental units roll on heavy-duty casters and are ideal for industrial applications such as: cooling water for low temperature viscosity tests, for film processing; for chill baths; for circulating tempered liquids through condensers; for cooling or heating reflux columns; for circulating constant temperature liquids, etc.

Encapsulated Motors

A NEW line of "Howellsealed" encapsulated motors . . . 3 or 2-phase, 1 through 125 hp a-c. squirrel-cage . . . is announced by Howell Electric Motors Company.

"Howellseal," according to the manufacturer, is a specially-developed epoxy compound . . . applied under vacuum to surround each wire in slots and at coil ends to produce a solid, void-free mass.

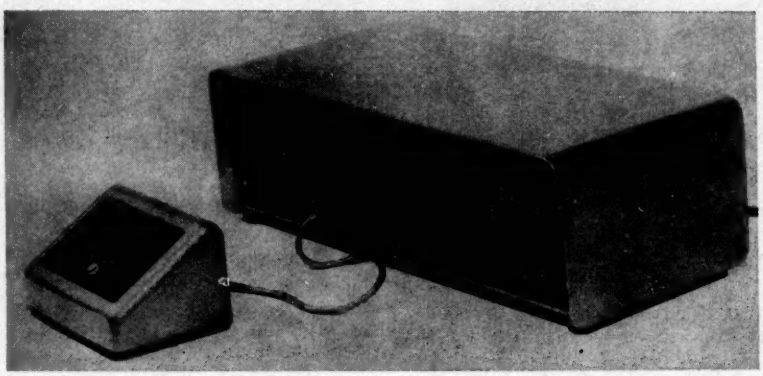
The announcement states these motors have the simplicity and high overload service features of standard open motors and, at the same time, provide the winding protection of enclosed motors at a 10% to 30% lower cost, depending upon motor size.

Howell states this new line provides open-motor performance for applications usually requiring enclosed motors because of exposure to excessive heat, moisture, acids, gases, salts, alkalis, caustics, fine abrasives, shock or vibration.

"Howellseal" motors are available in NEMA designs A, B, C and D for 1, 2, 3 or 4-speed constant or variable torque operation . . . all standard voltages and frequencies.

For details on available ratings, mountings and operating requirements, request Bulletin 1005 (E, F).

Quality Control Computer



PRESIDENT Bryant Craig of Diversa Electronics Corp. makes simultaneous announcements of his company's name change and the introduction of new product model of the Q-trol quality control computer. Craig formerly was president of Texas Electronic Products Corp. which has become a subsidiary of Diversa, Inc., industrial complex of food, electronics, banking, finance, and petroleum firms as well as sports enterprises.

The new Diversa Electronics Corp. presents the improved Model 60-D Q-trol quality control computer which provides an electromechanization of the Wald theory of sequential analysis, basis of modern statistical quality control through random sampling techniques.

Demonstrating widespread application to virtually every type of manufacturing industry as well as many service enterprises interested in improving the quality of products and services, such as in the food fields.

Improvements over the first Q-trol model introduced in early 1959 include completely redesigned computer package and operating elements; simplified formula-setting mechanisms; interchangeable components of standard design; relocation of signalling devices on both front and back Q-trol panels for quick reading from any angle; and foolproof operational controls.

A new business tool devised to improve and render more efficient the function of the quality control engineer in a large firm, the Q-trol is equally adaptable to the smaller firm for use by the plant superintendent to prevent the manufacture of faulty merchandise, cut down on material waste, prevent lost production time, and elimi-

nate customer complaints.

The Q-trol which is priced at less than $1500 automatically signals acceptance or rejection of product standards within set quality tolerances.

New Superintendent For Allied Baton Rouge Plant

»» THE appointment of Francis V. Toppin, Jr. as area superintendent of Baton Rouge Works of Allied Chemical's General Chemical Division has been announced by Frank M. Carroll, plant manager.

Mr. Toppin will supervise production "Genetron" fluorinated hydrocarbon refrigerants and aerosol propellants, and muriatic acid. He will also be in charge of a plant, now under construction, for production of the resin for General's newly-announced "Aclar" fluorohalocarbon film. This plant is scheduled to begin production early next year.

With the division eight years, Mr. Toppin was superintendent of its "Genetron" plant at Danville, Illinois for the past five. Earlier he served as assistant superintendent and general foreman of General's works at Marcus Hook, Pennsylvania.

Mr. Toppin is an alumnus of Stevens Institute of Technology at Hoboken, New Jersey. He resides at 11840 Mollylea Drive, Baton Rouge.

New Fuller Bulletin Lists Product Lines

»» EQUIPMENT for the process industries is described in a comprehensive new 12-page, two-color bulletin offered by the Fuller Co., a subsidiary of the General American Transportation Corp.

The new bulletin, G-3D, discussed applications and performance characteristics of Fuller-Kinyon pumps, Airveyor pneumatic conveyors, Fuller-Huron Airslide fluidizing conveyors, rotary compressors and vacuum pumps, horizontal-grate coolers, Fuller-Humboldt suspension-type preheaters, Sutorbilt positive displacement blowers and gas pumps, and Lehigh induced draft fans. Operating principles are explained, and photographs show typical installations.

Thirteen photographs and 18 drawings supplement the text material.

For copies of Bulletin G-3D, write the Fuller Company, Catasauqua, Pa.

Armour Appoints Two Distributors

»» TWO new ammonia distributors have been appointed by Armour Industrial Chemical Company, P. W. Fulford, ammonia sales manager, announced.

McKesson & Robbins, Inc., 1795 South High Street, Columbus, Ohio and The Thompson - Hayward Chemical Company, 3909 South Meridian, Oklahoma City, Okla., have been named authorized distributors for Armour anhydrous ammonia.

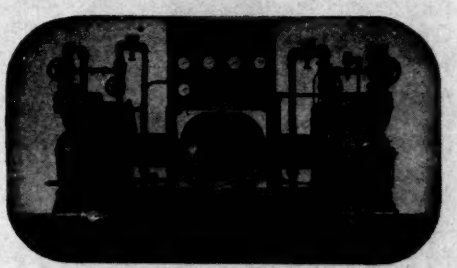
Both companies will handle sale of ammonia in cylinders and tank truck quantities. The recent additions bring the number of Armour ammonia distribution points to 185.

for LOWER COST, LOW TEMPERATURE REFRIGERATION
it will pay you to get the facts on
Creamery Package®
FACTORY-ASSEMBLED
2-STAGE AMMONIA COMPRESSOR SYSTEMS

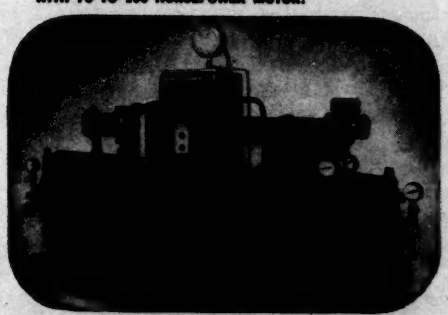
- provide automatic day-and-night low temperature refrigeration
- use 25% to 50% less connected horsepower than with single stage
- cost substantially less to own and operate
- takes small floor space
- for hardening room, frozen confection and low temperature food freezing

GET DETAILS NOW . . . see your CP REFRIGERATION ENGINEER, or write

THE Creamery Package® MFG. COMPANY
General and Export Offices: 1243 W. Washington Blvd., Chicago 7, Ill.
Branches in 23 Principal Cities
CREAMERY PACKAGE MFG. CO. OF CANADA, LTD., 267 King Street, West, Toronto 2B, Ontario



CP TYPE K AMMONIA 2-STAGE COMPACT ASSEMBLED UNIT 4 cyl. 5 x 3½ Booster with 4 cyl. 3½ x 3½ High Stage Compressor direct connected to a 1160 rpm. 60 H.P. motor. Temperature range —25° F to —55° F; 23.3 to 9.4 tons refrigeration; 54.2 to 36.3 brake H.P.; CAPACITY EQUAL TO 9 x 9, 2-CYLINDER VERTICAL COMPRESSOR @ 330 RPM OPERATING SINGLE-STAGE WITH 75 TO 100 HORSEPOWER MOTOR.



CP TYPE VS6-2 AMMONIA 2-STAGE COMPACT ASSEMBLED UNIT 6 cyl. 2¼ x 2 Booster with 2 cyl. 2¼ x 2 High Stage Compressor direct connected to a 1760 rpm. 20 H.P. motor. Temperature range —25° F to —55° F; 8.33 to 3.35 tons refrigeration; 21.5 to 14.00 brake H.P.; CAPACITY EQUAL TO 7 x 7, 2-CYLINDER VERTICAL COMPRESSOR @ 200 RPM OPERATING SINGLE-STAGE WITH 30 HORSEPOWER MOTOR.

Kohlenberger Appoints Barnard To High Post

Appointment of Charles G. Barnard to the board of directors of Kohlenberger, president of the Fullerton, California industrial refrigeration design and manufacturing firm. Barnard is secretary-treasurer of the firm. Barnard is responsible for the supervision and administration of all corporate accounting and financial functions. He was previously comptroller of Daystrom Mfg. Corp. in Fullerton; Chief Accountant for Daystrom at their Olean, N. Y. plant; Chief of the Audit Section of the Army's Philadelphia Ordnance District Procurement Agency; and Chief Cost Accountant at Dresser Mfg.

C. G. Barnard

A native of Olean, N. Y., Barnard is a graduate of the Wharton School of Finance & Commerce and has a B.S. in economics from the University of Pennsylvania.

Raymond Named Super Of Allied Danville Plant

››› THE appointment of Charles A. Raymond as superintendent of Danville (Illinois) Works of Allied Chemical's General Chemical Division has been announced by J. Steele Brown, vice president. He succeeds Francis V. Toppin, Jr., who has been named area superintendent of General's Baton Rouge (Louisiana) Works.

With the Company 14 years, Mr. Raymond was assistant superintendent of General's works at Calumet, Illinois for the past two. Earlier, he served in supervisory capacities at Danville and at General Chemical plants in Baton Rouge and Marcus Hook, Pennsylvania. He joined the Company as a control chemist with Allied's National Aniline Division in Buffalo, New York.

Mr. Raymond is an alumnus of Villanova (Pennsylvania) College with a B.S. degree in chemical engineering. His home is at 1520 East Liberty Street, Covington, Indiana.

Danville Works, one of General Chemical's 40 producing plants, is engaged in the manufacture of "Genetron" fluorinated hydrocarbon aerosol propellants and refrigerants, and of muriatic acid. "Genetrons" have extensive use as propellants for most types of aerosol products, and are employed as refrigerants in virtually all modern household, industrial and commercial air conditioning and refrigeration.

Grayson Named Manager Of Ringsby Refrigerated Division

››› H. N. "HERB" Grayson, Colorado trucking executive, was recently named to the position of general manager of the Refrigerated Division, Ringsby Truck Lines, Inc.

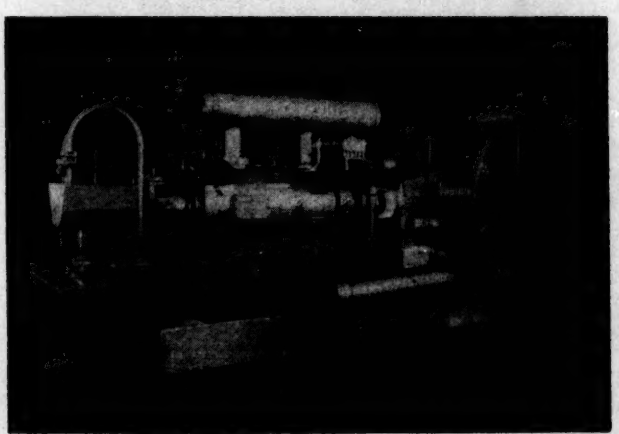
Announcement of the appointment was made by Gail H. Crawford, executive vice-president and general manager of the Denver-based transcontinental motor carrier. The appointment fills the vacancy created by Fred E. Day, Jr., former general manager of the Ringsby perishable commodity hauling division. Day's resignation was effective July 15.

No stranger to the problems of handling perishables, Grayson, prior to his association with Ringsby, served as both vice-president and later as president of a transcontinental common carrier engaged principally in hauling for the packing industry. Prior to his entry into the trucking field in 1957, he was active in insurance and claims investigation work in the Denver area.

H. A. Phillips Exhibit At Dairy Industries Show

››› H. A. PHILLIPS & Company will feature in their booth an Ammonia Liquid Circulating System including the accumulator, receiver, high side float valve, pressure regulator and liquid return system. This will be a complete package arranged for automatic liquid control. The model on display will be suitable for a 40 ton single stage refrigeration plant. Also on display will be cutaway models of refrigerant low side float valves, injectors, liquid filters, check valves, and liquid Level Eyes. Questions about the design and operation of flooded refrigeration systems will be welcomed by our technical service staff. Representing the company in the booth will be W. V. Richards, G. D. Bansch, Pauline Campbell Eileen Crowley, Joe Kupec, Bernard Miller, David Phillips, Mary Phillips, Wayland Phillips, Herb Rosen, R. R. Ross, and Alice Thiel.

Norwalk Company In Expansion Program



››› NORWALK Company, Inc. manufacturers of high pressure, air and gas compressors since 1864, has become a public corporation for the first time in its history.

The registration statement relating to the offering of 100,000 shares of Common Stock ($1.00 par value) at $5.00 per share has been filed and is effective with the Securities and Exchange Commission.

"This stock issue is concurrent with the expansion and new development at Norwalk Company, Inc.," stated Mr. Richard A. Steele, president and director. "We have already started our plans for additions and improvements of the com-

pany's plant, machinery and equipment. Norwalk Company, Inc. will keep up with the growth of the expanding world-wide industrial economy."

Compressors manufactured by Norwalk Company, Inc. are essentially standard units, but are designed, engineered and constructed to meet particular customer specifications. The company also supplies services of its specialist employees in connection with the erection, installation and maintenance of its compressors at customers' plant sites. Replacement parts for all Norwalk compressors are always available.

The use of high pressure compressors to achieve very low temperatures in air and gases has increased enormously to meet modern requirements of world-wide industry and research. Norwalk compressors are in use in almost every state of the United States and also in many foreign countries. The growth of the use of high pressure compressors extends into many diversified fields: commercial gas, oxygen and hydrogen plants, research and development laboratories, jet propulsion units, U. S. defense bases, food processing plants, petrochemical laboratories, chemical processing plants, metal fabrication factories, medical and therapeutic applications and many others. Particularly important has been the extensive use of high pressure compressors as an integrated facility in the entire field of missile and rocket developments and research laboratories.

Efficient Designs For Long Life And Low Maintenance

SHANK AMMONIA VALVES

Shank Valves have earned a reputation for high quality, long life and dependable products.
Built of highest grade materials with close tolerances—will stand most rigid inspections.
Largest line of Ammonia All-Steel Bar Stock Valves in the industry. Completely Cadmium plated.

STOCKED BY LEADING JOBBERS

Shut-Off Valves · Gauge Sets · Relief Valves · Expansion Valves · Write for Catalog

CYRUS SHANK COMPANY

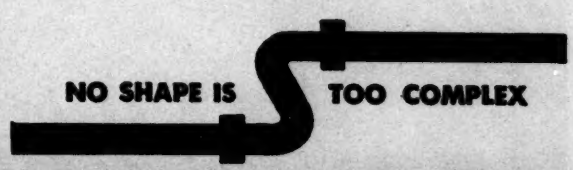
4652 West 12th Place, Chicago 50, Illinois

GENUINE OZITE®

STANDARD *ALL-HAIR* PIPE COVERING INSULATION

lasts a lifetime!

Genuine Ozite pipe covering insulation installs easily on curves, fittings, straight pipes or valves . . . stops wasteful heat absorption effectively and permanently. Ozite insulation also helps maintain uniform temperature and increase your equipment's refrigerating capacity. Try Genuine Ozite!



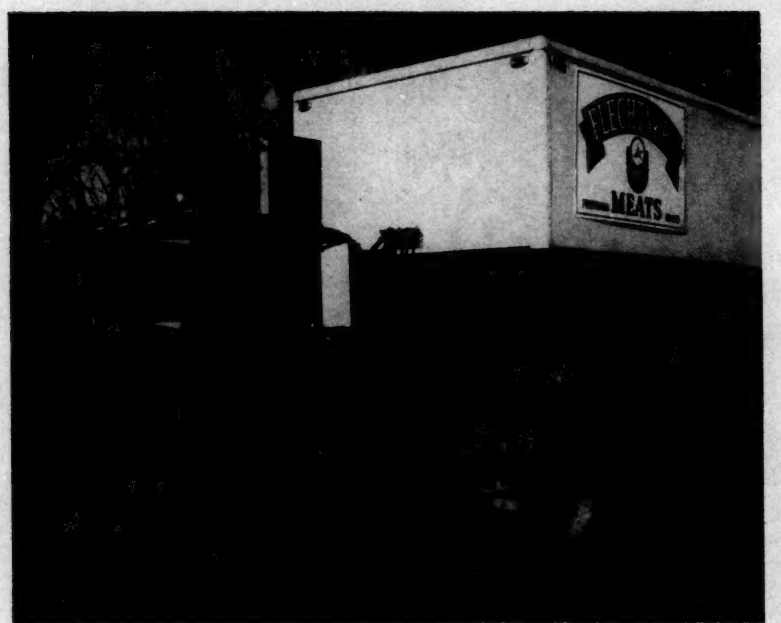
A PRODUCT OF

AMERICAN HAIR & FELT COMPANY

MERCHANDISE MART • CHICAGO 54, ILLINOIS

The right refrigeration system for the specific truck and job has provided Flechtner Bros. Packing Company, of Fostoria, Ohio, with refrigerated meat trucking at the greatest economy in operation. Three different methods are used on this group of trucks.

Meat Packer Selects Refrigeration Systems To Suit Truck Types



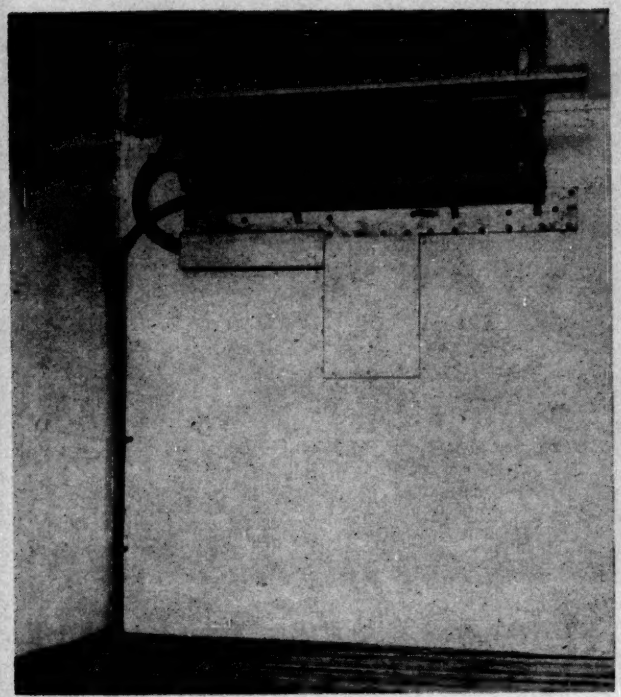
"Split" system permits installation of the condenser unit high and free from road dirt on the top of the cab of this tractor-trailer. Flexible drive shaft leads from the tractor motor to the compressor unit, mounted on the tractor chassis. Flexible shafts and lines connect these units and the blower inside the forward wall.

Careful selection of refrigeration systems for his fleet of trucks has paid off in maximum economy of operation for Dale McCarty, president of Flechtner Bros. Packing Company, Fostoria, Ohio. Low maintenance, accessibility, and minimum space and installation requirements were factors taken into consideration in the selections, he reports. Route lengths and number of stops also were important considerations, he adds.

The Flechtner Company processes and distributes meats to a large number of retail outlets with trucks making an average number of 30 stops per day on routes ranging from 75 to 150 miles per day.

Kold-Trux Mark systems with Super "35" blowers, manufactured by Tranter Manufacturing, Inc., were installed on Flechtner trucks having 15-foot bodies and a cargo capacity of between 12,000 and 16,000 pounds. Temperatures in these trucks are maintained at 38°F.

"We like the simplicity of this system," declares Mr. McCarty. "It makes a good light-weight unit with the big economical advantage of compactness, which of course gives us greater meat storage space in the trucks and a greater payload," he adds. This simple system transmits power through a flexible shaft and cushioning electric clutch from the truck engine crankshaft pulley to the condensing unit, mounted just behind the cab.



Blower evaporator, designed by Tranter Manufacturing, Inc., for medium temperature bodies up to 14 feet long, is used in Flechtner truck for meat refrigeration. Space saving "ribbon" design allows more load and aisle space for meats. Closely controlled defrosting and wide fin spacing produce cooling power.

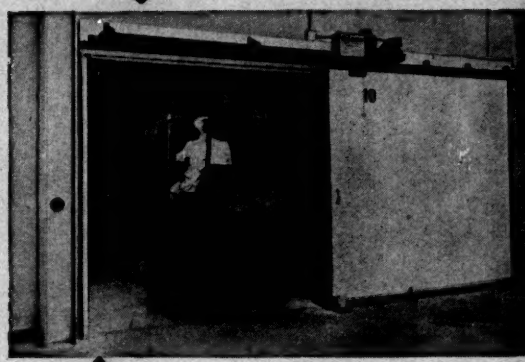
The condensing unit is connected to the evaporator, mounted high on the inside front body wall. This particular blower produces very rapid temperature recovery after door openings.

Mr. McCarty has discovered that another system has produced very satisfactory results on a tractor-trailer unit in his truck fleet. This is called a "split" Mark system. The condenser is mounted on the cab roof, where it is able to take in clean air, and is ideal for trucks operating under conditions of excessive road dirt.

The compressor on the "split" system is mounted against the tractor chassis just behind the cab and is completely enclosed for maximum protection. As in the regular Mark system, the compressor is driven by a flexible shaft from the truck motor. The trailer is a 16-foot body with a load capacity of between 10,000 and 16,000 pounds. Temperature is maintained at 36°F in this unit.

Two of the Flechtner trucks are equipped with Kold-Hold Crest condensing units, specifically designed for freezing their hold-over plates during parking or "standby" or overnight. The units operate when plugged into an electrical outlet. Temperatures are maintained most economically in these particular trucks at 35° to 38°F through this system. The trucks have 14-foot bodies and load capacities of 10,000 to 12,000 pounds of meat.

Why pay for *more* Door Insulation than you *really* need?



NEW
PREST-O-MATIC®
LIGHT COOLER DOOR

Maintains desired temperatures between 45° and 70°

If you're concerned with moderate temperature areas rather than zero degree refrigeration, here is the answer you've waited for!

The new PREST-O-MATIC Light Cooler Door gives you all the insulation you need at a *considerable saving in cost.* Engineered with famous CLARK know-how to fill the gap between thickly insulated doors and ordinary doors which offer unsatisfactory protection.

Available with either 2" or 3" foam insulation as required, instead of the heavier 4"-6" insulation needed for true refrigeration. For use at temperatures between 45° and 70°. Ideal, too, for doorways between rooms of different temperatures within the moderate range. Puts no excessive weight on free standing walls. The PREST-O-MATIC Light Cooler Door comes in a complete, easy-to-install unit. Occasional lubrication assures years of trouble-free operation.

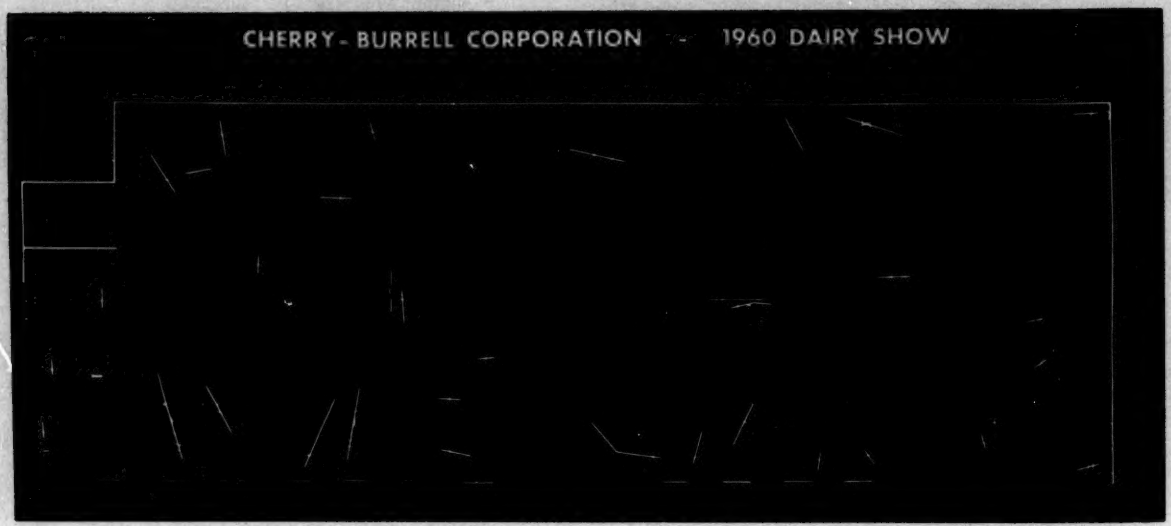
See our insert in Sweet's Catalog or, better still, write today for full information.

- Wedge-tight perimeter seals
- Full length safety edge
- Air or Electric power operator
- 2" or 3" foam insulation
- Exclusive Prest-O-Matic inclined track
- Complete unit—easy to install
- Needs practically no maintenance

CLARK DOOR COMPANY INC
506 Hunterdon Street
Newark 8, New Jersey

Manufacturers of Single, Double Sliding, and Bifold Cooler and Freezer Prest-O-Matic Doors.

Automated Ice Cream Plant At Dairy Show



»» AUTOMATED milk and ice cream plants of the future will be diagramed by Cherry-Burrell Corporation engineers for visitors to the company's exhibit at the 1960 Dairy Show, according to Howard H. Cherry, Jr., president.

These diagrams and the equipment displayed will point up pioneering done by Cherry-Burrell engineers in the development of high capacity equipment and fully synchronized, automatic processing systems for the dairy industry.

Also stressed are mechanized package handling and "cleaned-in-place" equipment, both of which are essential to automated dairy processing systems.

The elaborate 3800 square foot exhibit—largest in the show—will include:

—Operating push-button control panels, load cells, and other components of the Load-A-Matic electronic system of synchronized production.

—Latest models of high capacity processing machines, such as the 1,000 gallon per hour Vogt freezer, Aro-Vac Flavorizer, Superhomo Homogenizer and Superplate Pasteurizer.

—An operating, fully automatic materials handling display featuring casers, stackers, power link conveyors, on-floor conveyors, case unstackers.

—An operating 1,000 gallon processor hooked up with an air actuated valve and pump for in place cleaning.

—An extensive sanitary fittings display, including all types of fittings—threaded, clamp, bolted clamp, and welded line.

Also displayed are:

500 gallon Super Syrup Maker, pump display, welding unit display, 648 Thermutator, SPXT 300 gallon farm tank, 300 gallon cylinder farm tank, V-301 freezer, V-403 freezer, FFH fruit feeder, AR CS display, pre churn, SS-800 VBR homogenizer, homogenizer parts.

In addition the exhibit includes: SS-7500 Homogenizer, K6-18 Filler, MM-13004 Westfalia, Layering Caser, Polybag Filler, Power Link Conveyor Loop, Paper Case Unstacker, Can Filler, Model EK Stacker, Spiraflex Display, H-9 Caser.

Cherry-Burrell headquarters during the Dairy Show will be at the Congress Hotel. Booth number at the Amphitheater is R-240. Key personnel include Howard H. Cherry, Jr., president; David M. Mojonnier, Dennis T. Fitzmaurice, John J. Murphy, J. R. Frye, E. H. Forster, G. H. Tellier, F. A. Lackner, F. H. Harwood, and branch managers, branch engineers, and sales representatives.

Direct Channels For Carbon Dioxide Sales

»» PUBLICKER Industries, Inc., announces the establishment of direct sales distribution channels for the carbon dioxide products of its subsidiary, ThermIce Corporation.

With this move, ThermIce becomes one of five companies of its kind in the United States which produces and distributes carbon dioxide in all three forms—dry ice, liquid and cylinder.

Using the trade name of "ThermIce", Publicker has been producing carbon dioxide for wholesalers for more than thirty years. Henceforth, ThermIce will have its own outlets in all major markets of the United States and will reach all levels of distribution.

In addition to its headquarters in Philadelphia, ThermIce has now opened offices in New York, Chicago and Boston. Robert E. Glass is the company's general manager; Bert Lowenthal is eastern regional manager and Robert P. Richards, midwest regional manager. All three men have had many years of experience in the carbon dioxide field.

Carbon dioxide has a wide variety of uses, and new uses for it are constantly being discovered. It is now used in such diversified fields as manufacturing, storage, transportation, refrigeration, fire protection, food processing, foundries, industrial testing, chemicals, pharmaceuticals, beverages, national defense materials.

Alco Valve Sales And Engineering Staff Meeting

Engineering and Sales Staff members of Alco Valve Company in meeting to hear Dr. Walker speak on desiccant.

»» DR. WALTER O. Walker, Dean of the Division of Research and Industry, one of the outstanding authorities on desiccants in the refrigeration industry, was guest speaker at a recent two day engineering conference of the Alco Valve Company, at the Coronado Hotel, St. Louis, Missouri. The conference was attended by Alco's engineering staff and sales force. The purpose of the conference was the detailed indoctrination of the technical aspects of a completely new, exclusive refrigerant block form desiccant, combining Silica Gel P. A. 400 and Molecular Sieve.

This important contribution to the refrigeration industry was made possible through a grant to the Industrial Chemical Research Laboratory of the University of Miami, which is under the direction of Dr. Walter O. Walker, Dean of the Division of Research and Industry, working in cooperation with the Alco Valve Company's Research Laboratory in St. Louis.

Extensive laboratory and field testing of this new block type filter-drier during the past seven years has demonstrated that these desiccants, bonded in rigid form (approximately 3% binder) by an accurately controlled forming process (without pressure), creates high mechanical strength which will not permit separation under liquid surging or severe shake-up.

Further, the geometry of this block exposes maximum surface to the liquid flow and assures even distribution of filtered particles, resulting in filtration in depth, thus preventing rapid rise in pressure drop. These features also assure longer filter-drier operational life.

In addition to the high filtering qualities, the combined desiccants adsorb acids and colors and because of the low amount of binder required for mechanical strength, the Alco Dri-Kleaner contains nearly (approximately 97%) pure desiccants, making it possible to easily meet the ASRE-ARI Standards.

Stokes Will Take Part In Conference On Freeze-Drying

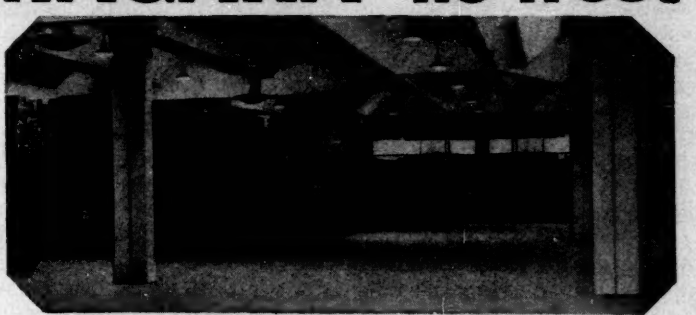
»» F. J. STOKES Corporation, Philadelphia, a pioneer in the development of the freeze-drying process in the United States, will be represented at the Second International Conference on Lyophilization which opens late this month in Lyon, France.

Samuel C. Tease, Stokes' specialist on vacuum freeze-drying equipment, leaves Philadelphia for Europe by air on August 27 to attend the conference, which runs from August 29 to September 9.

The international exchange of information on this important process is expected to draw representatives from more than 30 countries. The Conference is sponsored jointly by the International Institute of Refrigeration and the International Association of Microbiological Societies.

Stokes was also represented at the first of these International Conferences, which was held in 1958, also at Lyon.

NIAGARA "no frost"



NO RISK OF DAMAGE TO FOOD QUALITY

● Operating men, who know both costs and profits, will tell you that Niagara "No-Frost" gives you the best operation in frozen foods... both in freezing and in warehousing where trustworthy, safe storage temperatures must be combined with building layout that lets you *move* goods... not just store them. Only Niagara methods give you safe and even temperatures with over 20' head room so that you can use your fork lift trucks and palletized warehousing efficiently. And "No-Frost" refrigeration shows the lowest upkeep costs in the business.

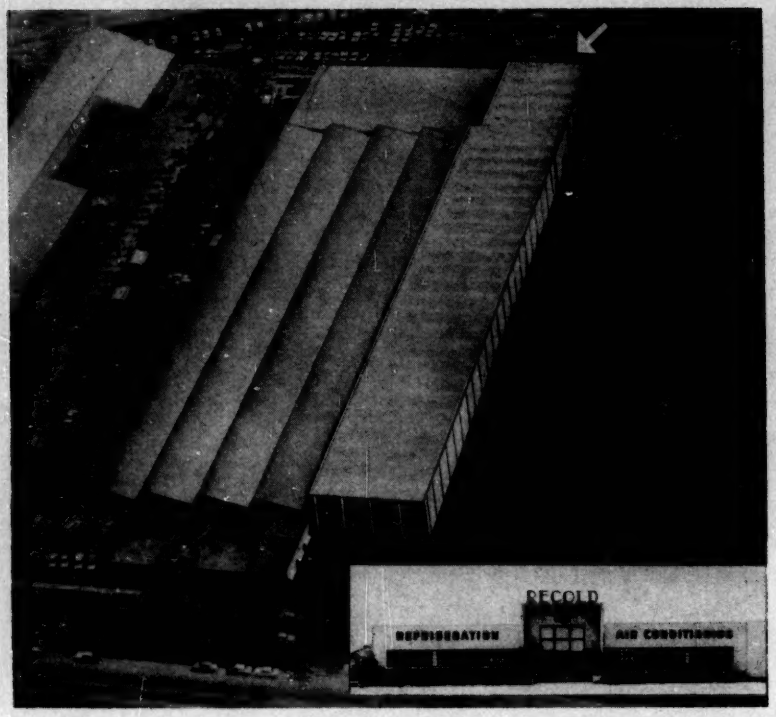
Write for Bulletin No. 105

NIAGARA BLOWER COMPANY

Dept. IR-10, 405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities

Recold Reports On Plant Expansion



The first phase in Recold Corporation's new 40% expansion program is the completed 49,000 foot addition to the present plant indicated by the arrow at the top of the photo.

»» RECOLD Corporation has announced that the first phase of a 40 per cent plant expansion program and a change in production procedures aimed at doubling output of its air conditioning and refrigeration product has been completed.

The first phase—the addition of 49,000 square feet to the present plant—has just finished, and the change-over in production procedure, the second phase, is scheduled to start soon, reports H. T. (Hy) Jarvis.

The additional space in the plant brings the total square footage to 169,000. The Recold plant is located on a 13-1/2 acre site and Recold officials point out that this still leaves ample room for more expansion.

The basic change in the production system, according to Carl Baumhofer, works manager, "is the creating of a line flow by separating copper fabrication from steel fabrication and placing supporting fabrication in the center."

Baumhofer explained that prior to this Recold's production system was departmentalized by the kind of product in fabrication.

Some of the new equipment to be used in the changeover includes presses to increase the current capacity of fin fabrication and of copper header fabrication; a 200-ton blank and form press; a 300-ton press brake; a Wales fabricator, and two 60-ton blank and form presses.

The revamping of plant facilities is expected to be completed by October.

York Promotions

»» HENRY H. Kirkpatrick, former Sales Promotion Manager for Engineered Machinery at the York Division of Borg-Warner Corporation, was recently named manager, Advertising and Sales Promotion Services, by Todd L. Owens, manager of Advertising and Sales Promotion.

Kenneth J. Thompson former sales promotion manager for Packaged Products has been promoted to sales promotion manager for all York divisions.

Freeze-Drying Food Described To Chicago Symposium

»» EQUIPMENT for processing foods by vacuum freeze-drying in tonnage quantities, developed by F. J. Stokes Corporation, Philadelphia, was described to an all-day symposium on this subject held in Chicago, at the Stockyards Inn, on September 21.

The Stokes paper, one of several given on this general topic, was delivered by John F. Maguire, product manager of Stokes' Vacuum Processing Equipment Department.

The symposium was part of a two-day conference on food preservation by freeze-drying and other dehydration methods arranged by the Food and Container Institute, a branch of the Army Quartermaster Corps' Research and Engineering Command.

Stokes, a pioneer in the development of the vacuum freeze-drying process, has led the way in recent years in the successful application of this process to the preservation of foods. The method had already established its value in the preparation of anti-biotics, vaccines and other pharmaceutical materials. Stokes has supplied or is currently building the majority of the equipment that is being used in this country for the production-scale freeze-drying of foods, such as meats, fruits, vegetables, and seafoods.

Tenney Engineering To Acquire Communication Measurements Lab

»» TENNEY Engineering, Inc., of Union, N. J., largest and oldest manufacturer of environmental test equipment and of refrigeration and air conditioning components, has contracted to acquire Communication Measurements Laboratory, Inc., of Plainfield, N. J.

CML makes electronic generators and instruments for space systems and for scientific and industrial quality testing.

Saul S. Schiffman, chairman of the board of Tenney, described the move as "an important expansion of our activities in the electronics field." It is expected to add a million dollars a year to Tenney's sales volume.

The acquisition mainly involves the exchange of Tenney stock, which is traded on the American Stock Exchange. CML has been privately owned.

CML will be operated as a wholly-owned subsidiary and will continue with the same personnel, although its staff will be enlarged and its scope of operations broadened.

"CML's activities," Mr. Schiffman said, "fit into our long-range program and supplement our research, development and testing experience."

Hawkins Retires From Quartermaster Service

>>> JOHN A. Hawkins, civilian expert on storage and refrigeration for the Army since 1941, retired from Government service August 31. Hawkins, 65, completed 19 years of service with the Army Quartermaster Corps at the Military Subsistence Supply Agency in Chicago. There he was assistant chief of the national food supply agency's requirements and distribution division.

At retirement ceremonies at the Agency's Chicago headquarters, he was presented an Army certificate of achievement by Maj. Gen. Hugh Mackintosh, MSSA's executive director. General Mackintosh credited Hawkins for his contributions to the war effort in 1941-45, for improving the transport of perishable foods to the Far East in 1946 and for contributions in developing the effective system the single-manager defense agency uses today to supply foods to the Armed Forces.

General Mackintosh expressed the good wishes and godspeed of

John A. Hawkins (right) is congratulated and presented "Certificate of Achievement" by Major General Hugh Mackintosh, Military Subsistence Supply Agency, United States Army.

the Agency's 1500 employees when he told Hawkins he could "look back on a job well done."

Hawkins, who had his own warehouse business before the War, joined the Army's civilian staff in 1941 as consultant in refrigeration to The Quartermaster General. He was assigned to the Quartermaster Market Center System in 1945 as director and coordinator of its west coast market centers. His final QM assignment in Chicago began in 1957.

Hawkins is a member and former national president of the National Association of Practical Refrigerating Engineers, an honorary life member of the National Association of Refrigerated Warehouses and a former member of the American Society of Refrigeration Engineers.

With Mrs. Hawkins he plans to enjoy retirement years in southern California.

Eby Is Marketing Manager Armstrong Cork Company

>>> S. WARREN EBY has been appointed marketing manager, refrigerated equipment sales, a department of the equipment insulation, siding and mobile home products sales department, Armstrong Cork Company.

Eby, a native of Lancaster, joined Armstrong as a laboratory assistant in 1937. He received a B.S. Degree in Physics from Franklin and Marshall College in 1949 and was named a physicist in the Company's Research and Development Center in 1952.

He was transferred to the Insulation Division in 1955 to handle technical services for the Equipment Insulation Department.

New Study Analyzes Merits And Demerits Of Truck Fleet Leasing

>>> A NEW study, just published by the Foundation for Management Research, analyzes the merits and demerits of the main types of truck fleet leasing plans, and compares their cost with company ownership of truck fleets.

It is entitled: "Truck Fleets: Lease or Buy? An Analysis of Truck Transportation Costs." The 32-page study is the third in a series on leasing which has been developed by the Foundation. The study is based on data gathered from corporations operating 12,817 company-owned trucks, and the records of national truck leasing companies.

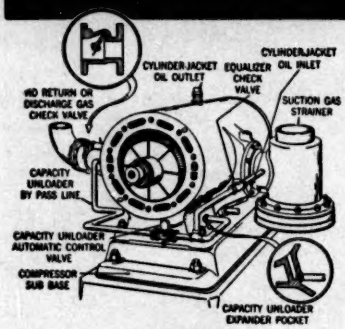
Four complete tables are included in the study, which analyze company-owned fleet costs and

DOLE
Heat-Cel
LOW TEMPERATURE
AUTOMATIC
DEFROST
RE-EVAPORATOR UNIT
ELECTRIC
FAST HEAT TRANSFER FOR QUICKER DEFROSTING!
Heat for re-evaporation supplied by low wattage electrical element. Consistent, economical, performs in any ambient. Designed by specialists in the low temperature field. Get all the facts. Write for Heat-Cel engineering catalog.
DOLE
THE Cel LINE
DOLE REFRIGERATING COMPANY
5938 NORTH PULASKI ROAD, CHICAGO 46, ILLINOIS
103 PARK AVENUE, NEW YORK 17, N.Y.
DOLE REFRIGERATING PRODUCTS LIMITED
OAKVILLE, ONTARIO, CANADA
*
Heat-Cel
CONVENIENT PLATE DESIGN
ALLOWS FLAT-AGAINST-WALL MOUNTING

Most Popular Refrigeration Booster

FULLER ROTARY

featuring capacity unloading


CYLINDER JACKET OIL OUTLET
CYLINDER JACKET EQUALIZER CHECK VALVE
CYLINDER JACKET OIL INLET
SUCTION GAS STRAINER
HD RETURN OR DISCHARGE GAS CHECK VALVE
CAPACITY UNLOADER BY PASS LINE
CAPACITY UNLOADER AUTOMATIC CONTROL VALVE
COMPRESSOR SUB BASE
CAPACITY UNLOADER EXPANDER POCKET

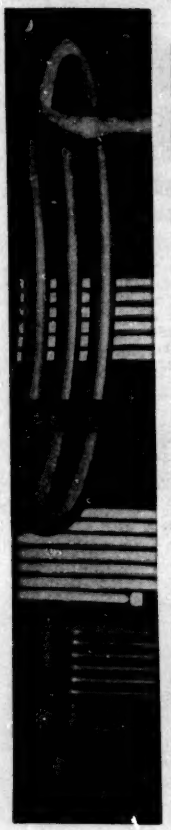
FES FULLER C-339 4448

FREEZING EQUIPMENT SALES, INC.

1405 N. Duke St., York, Pa.

Qualified distributors in principal cities

LOW TEMPERATURE FREEZING EQUIPMENT



PIPE BENDS

Coils, Headers and Fabrications . . .

the tougher the job, the better our expert metalworkers like it. With their modern equipment, they produce the finest work to your precise specifications. In any metal, even stainless steel, or up to 6-inch extra heavy. For fast, quality bends, backed up by more than 40 years specialization, call on us!

May we quote on your next job?

CHICAGO NIPPLE MANUFACTURING CO.

1997 Clybourn Chicago 14

compare those costs with leasing. The study develops a "cutoff point" to aid company financial officers in determining when it is more profitable to lease truck fleets and when it is more profitable to own them, Also included is an analysis of the different lease plans available, pointing out which plans are best for companies with specific transportation problems.

Single free copies of this study may be obtained by executives by writing to the Foundation for Management Research, 121 West Adams Street, Chicago 3, Illinois.

Report Tells How Dairy Improved Refrigeration Facilities

››› HOW Delvale Dairies, Inc., Baltimore, Md. added hardening room space, increased hardening room efficiency, and saved $12,000 a year in labor costs—within existing plant space—is described in a four-page technical report now being offered by Freezing Equipment Sales, Inc., York, Pa.

This report tells how Delvale both consolidated its hardening systems and completely automated them.

Additional results of this consolidation are described, including increased efficiency and economy of operation, a complete cutting of refrigeration loss, reduced maintenance cost, and constant temperature control.

For copies of this reprint, "Delvale Improves Refrigeration Facilities," write Freezing Equipment Sales, Inc., 1405 N. Duke St., York, Pa.

New Water Conditioning Maintenance Manual

››› HOW to secure crystal clear, non-corrosive, non-clogging, non-precipitating water at lowest cost for commercial, industrial and home use is described in a new 24-page brochure released by Stiles-Karlsonite Corporation, Waukegan, Illinois.

Titled "Water Conditioning with Karlsonite for Preventive Maintenance", the brochure discusses such common water problems as scale, corrosion, algae and slime.

The use of Karlsonite chemicals as effective water conditioners for cooling towers, evaporative condensers, water cooled equipment, ice cubers, well water supplies, etc. is covered in detail, together with Stiles-Karlsonite Automatic Dispensers recommended for each application.

Water testing instructions, installation procedures, and useful water data and conversion tables are also included in the new brochure.

Copies of the brochure will be sent, on letterhead request, by writing Stiles-Karlsonite Corporation, Waukegan, Illinois.

OTS Bibliographies Published For Eight Special Categories

››› EIGHT Selective Bibliographies, listing the latest Government research reports and other technical documents available to science and industry, have been published by the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce.

Publications listed in the bibliographies cover such topics as food preservation, welding techniques, corrosion control, reliability and quality control in electronic equipment, linear programming, developments in adhesives, wood research, and studies of rare earth elements.

A complete list of OTS Selective Bibliographies as well as Catalogs of Technical Reports (the former name of the Selective Bibliographies) is available from OTS, U. S. Department of Commerce, Washington 25, D. C. Among the eight new Selective Bibliographies is: SB-403 **FOOD PRESERVATION BY IRRADIATION** (Supplement to CTR-357). 10 cents.

Bulletin On Water-Cooled Condensers Available

››› A NEW bulletin on mechanically cleanable water-cooled condensers for refrigeration is being offered by Halstead & Mitchell Co., Pittsburgh, manufacturer of refrigeration components.

The bulletin emphasizes the advantage of true counterflow which Halstead & Mitchell offers for maximum heat exchange over the total length of the condenser tubes. This produces an average of 7-1/2 per cent more system capacity without

additional power input, tests reveal.

H&M water-cooled condensers listed in the new bulletin are designed for refrigeration systems where minimum space requirements prevail.

Sizes covered range from 1/3 ton to 25 tons in standard, heavy duty, R series close-coupled, WR series multi-section, and SW series to operate on sea water or under corrosive conditions.

Charts showing water consumption and pressure drops for the various models also are included. For a copy of Bulletin WC-300, write to Halstead & Mitchell Co., Bessemer Building, Pittsburgh 22, Pennsylvania.

Water Conditioning Data Sheet

»» BETZ Laboratories, Inc., consultants on industrial water problems, has made available a new water conditioning data sheet entitled, "Slime Control with Chlorine and Non-Oxidizing Biocides".

This data sheet discusses how the judicious use of chlorine and the supplemental use of other biocides will extend cooling tower life.

Copies of this new water conditioning data sheet are available by writing to Betz Laboratories, Inc., Gillingham & Worth Streets, Philadelphia 24, Pa., or through your Readers' Service Department.

Information On Sealed Rotary Switch

»» A NEW catalog which describes in detail the recently standardized 150,000 Series hermetically sealed rotary switch has just been released by Ledex Inc., of Dayton, Ohio.

Contained in the 13-page catalog are three sections which illustrate 3072 standard designs, including dimensions, drawings, mountings, receptacles and wiring. Also included is complete control and performance data, environmental conditions, duty cycles, voltage codes, and approximate "hold-in" resistor values.

Valuable to engineers in selecting hermetically sealed switches best suited to their applications, copies may be obtained by writing to Ledex Inc., Dayton, Ohio. Ask for Bulletin D-460.

Classified Advertising

All classified advertisements are payable in advance. Except for Positions and Help Wanted classifications, this section is reserved exclusively for USED equipment.

RATES: 20c per word; minimum 25 words. $2.00 per line for bold face headings: $15.00 per inch for line listings.

Position and Help Wanted

WANTED—experienced operating engineer wanted for 300-ton plant; car ice only. Write to P. O. Box 122, El Paso, Texas.

WANTED—EXECUTIVE qualified to take complete charge of production, management and operations of large, frozen food processing plant in the east. Write Box OC-4, c/o Industrial Refrigeration.

CHIEF ENGINEER

For major cold storage warehousing and ice company with mult'-plant operation. Company is growing and diversifying. Want college graduate with at least 10 years practical experience who can take complete charge of refrigerating, construction and maintenance of company properties. Must have previous experience in ammonia systems, know all major lines of refrigeration equipment, and be able to design, layout and redesign both new and existing refrigeration systems in ice plants and cold storage warehouses. Must have prior supervisory experience and be able to work maintenance and construction crews and engineers. Travel involved. Salary open. Age to 45. Send resume with details of education, work experience, salary requirements, and photo to Box OT-6, c/o Industrial Refrigeration.

USED EQUIPMENT—wanted & for sale

WANTED—Practically new 30 to 40 ton plant to be dismantled and moved. Prefer grid tank with 11" 300# cans. Write Box AU-3, c/o Industrial Refrigeration.

FOR SALE—AMMONIA EQUIPMENT

2— 300 ton Niagara evaporative ammo. condensors.
1— 14x12" 4-cyl. Frick comp. D.C. to 600 h.p. motor, 327 r.p.m.
1— Worthington horiz. booster D.C. to 150 h.p. motor, 300 r.p.m.
2— 1 ton York ice making plants, 50# blocks, portable gasoline driven.
1— 10x10" 4-cyl. Frick duplex D.C. 225 h.p. motor.
3— 10x10" 4-cyl. York duplex D.C. 225 h.p. motor.
1— 9x9" 4-cyl. York duplex D.C. 150 h.p. motor.
3— 10x10" 2-cyl. York D.C. to 100 h.p. motor.
1— 9x9" 2-cyl. York D.C. to 75 h.p. motor.
2— 10x10" 2-cyl. York with V-type flywheel.
1— 9x9" 2-cyl. York with V-type flywheel.
2— 7-1/2"x7-1/2" & 8-1/2"x8-1/2" 2cyl. Vilters.
3x3", 4x4", 5x5" & 6x6" York & Frick comp.
3x3", 4x4" & 5x5" York Condensing units.
4— shell and tube condensers, 25 ton cap.
2— 300# Flynn & Emerick ice cubing machines.
2— 800# Gifford Wood ice cubing machines.

ENTERPRISE EQUIPMENT CORPORATION
328 Bryant Ave., Bronx 59, N. Y.
Cable "ENTREMA" Phone DAyton 8-2121

REFRIGERATION EQUIPMENT FOR SALE
Advise Us Your Needs
Use QUICKSEAL—stops brine tank leaks.
Use CLERTEMPICE—clears and tempers ice.
Born Company 30 East Jackson Boulevard.
Chicago 4, Illinois. WAbash 2-3230.

FOR SALE—3 late model Vilter ammonia compressors, synchronous motors; excellent condition; erected in closed plant, Cleveland, Ohio. Write for details—Box OT-5, c/o Industrial Refrigeration.

FOR SALE—York 7½x7½, 8x8, 9x9 with AC motors and starters; recently reconditioned, erected former Goebel Brewery, Muskegon, Mich., Will sell separately at reasonable prices. Write for details. JACO Equipment Corp., 3080 Main St., Buffalo 14, N.Y. Phone AMherst 2100.

WANTED—Used "Freon" 12 or 22 compressors 30 to 50 ton at 40 deg. evap. with or without motors for 440 volt, 3 phase. Bailey Distributors, Inc., 74 Sullivan St., Brooklyn 31, N. Y. ULster 5-3958.

FOR SALE—Frick 10x10 ammonia compressor with 220 volt, 100 h.p. motor. Price $2200.00; can also furnish 50-ton evaporative condenser. Price $750.00 "as is", "where is". Address Box OT-2, c/o Industrial Refrigeration.

FOR SALE

2—100 h.p. Carrier brine chilling units.
2—11x9 York compressors.
1—10x10 York direct connected to 100 hp.
2—8x8 York compressors 360 rpm. syn. motor.
2—5x5 Yorks w/evaporative condensers.
1—40 hp. Frick Eclipse comp. with diffusers.
3—Niagara #633 no frost spray coolers.
11½x22½x44" ice cans in grids of 4.

JOHN F. CARSON
A & Venango Sts. Philadelphia 34, Pa.
GArfield 6-2221

Plant For Sale

FOR SALE

Modern 140,000 cu. ft. brick freezer storage with large plot of ground for expansion. Ideally situated for frozen food processor. R.R. siding and truck docks. Overnight R.R. and truck service to New York City, Philadelphia, Boston, Cleveland, Pittsburgh. 2 hours to Buffalo, 3 hours to Rochester, New York.

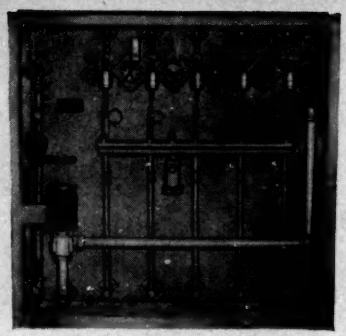
WM. F. ENDRESS, INC.
66 Foote Ave. Jamestown, N. Y.

Miscellaneous

FOR SALE—PATENT RIGHTS
to modern tunnel freezer. Write Box 2722, Baltimore 25, Maryland.

The "King Zeero" Ice Building and Cooling System

☆ No Moving Parts ☆ No Mechanical Agitation ☆ Negligible Maintenance



"King Zeero's" NEW Combination
PURE WATER COOLER and ICE BUILDER
Front View

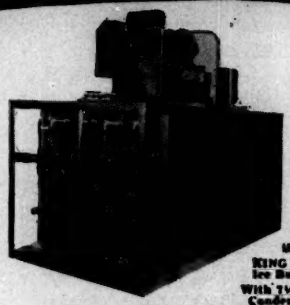
For INGREDIENT and WASH WATER APPLICATIONS
Provides a Clear Odorless, Palatable, Filtered Cold Water Supply

Patented Built-In Louvers provide Automatic Agitation without extra power

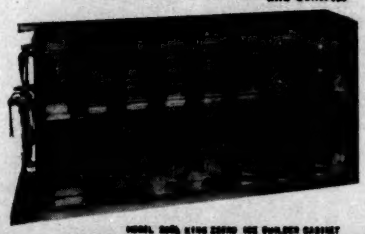
Stored Ice and Direct Expansion furnish 32°-34° circulating water for all product cooling needs.

Remember, the "King ZEERO" delivers the COLDEST water LONGER for less outlay.

THE KING ZEERO May also be used with an AIR CONDITIONING UNIT



MODEL 400A
KING ZEERO
Ice Builder Cabinet
With 7½ H.P. Freon Condensing Unit and Controls



THE KING ZEERO COMPANY 4300-14 W. Montrose Ave. Chicago 41, Ill.

Manufacturers of Ice Builders - Ice Builder Cabinets - Ice Banks - Pure Water Coolers

ADVERTISERS

Allied Chemical Corp., General Chemical Div. ..... Back Cover
American Hair & Felt Co. 31

Baltimore Aircoil Co. 19
Butcher Boy Refrigerator Door Co. 1

Chicago Nipple Mfg. Co. 38
Clark Door Co. 33
Classified Advertising 39
Creamery Package Mfg. Co., The 29

Dole Refrigerating Co. 37
Dow Chemical Co., The ..... 20 and 21

Freezing Equipment Sales, Inc. 38

Howe Ice Machine Co. 8

King Co. of Owatonna, The 8
King-Zeero Co. 40
Kohlenberger Engineering Corp. 2

Niagara Blower Co. 35

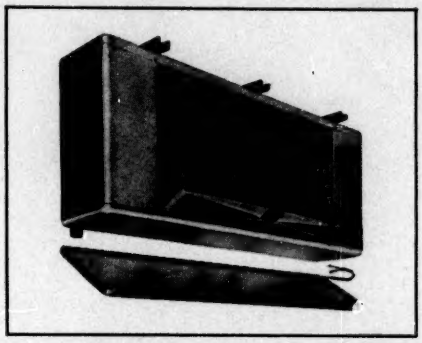
Phillips Co., H. A. 5

Safeway Heat Elements, Inc. ..... Inside Back Cover
Shank Co., Cyrus 31
Sporlan Valve Co. ..... Inside Front Cover

Wanted and For Sale Advertising 39

Versatile...

Custom-made for Rocketdyne Redstone engine propulsion system, flexible tube heaters provide uniformly dependable heat to all surfaces of the components.



Dunham-Bush refrigeration system, showing Safeway heating blanket fitted to drip pan—prevents re-freezing of water during defrosting.

Electrical thermal de-icing boots on aluminum alloy blades of Curtiss-Wright Electric propellers. Also used on extruded hollow steel blades on Electric and Turbolectric propellers.

SAFEWAY Heat Elements solve cold problems everywhere!

From economically solving a defrosting problem in industrial refrigeration to dependably protecting aircraft and engines in icy aero-space—that's some idea of the performance range of Safeway Heating Blankets and Elements.

For these and scores of in-between applications, Safeway products assure thoroughly reliable *controlled heat*, regardless of environmental temperature.

If you have a "cold-control" problem, put Safeway's modern manufacturing facilities to work for you—devoted exclusively to the design, engineering and manufacturing of heating, de-icing and de-frosting units, such as:

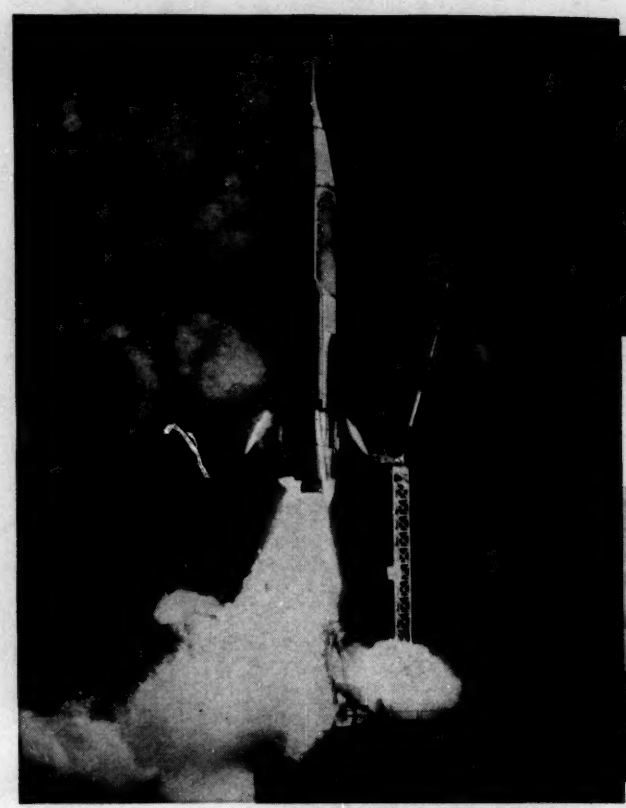
- heating elements for launching equipment and for airborne gyros, cameras, computers, servos and batteries—for missiles or aircraft
- de-icing units for airfoil surfaces
- heating elements for all types of ground support equipment
- defrosting units for industrial and commercial refrigeration
- heating blankets for honeycomb and metal-to-metal bonding

For your copy of a fact-filled folder, please write:

If it has to be heated (and the "it" can be just about anything), you can rely on SAFEWAY engineers to study your problems carefully, and—without any obligation—submit an appropriate recommendation.

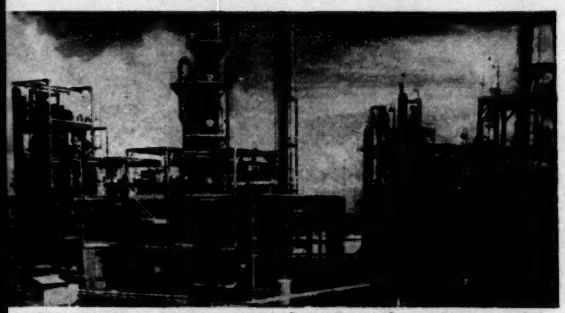
Safeway HEAT ELEMENTS INC.

Middlefield Street • Middletown, Connecticut



Providing tremendous thrust, new rocket fuel oxidizers such as liquid fluorine, chlorine trifluoride and other halogen fluorides may help us conquer space. Like "Genetron" fluorinated hydrocarbon refrigerants, they are important developments of General's long research in fluorine chemistry.

Largest privately-owned fluorine producing facilities in the world are located at General Chemical's Metropolis, Ill., Works. In these cells elemental fluorine is produced for use as a high-energy oxidizer of rocket fuels and for production of uranium hexafluoride for the Atomic Energy Commission. Allied Chemical's leadership in fluorine chemistry is applied to continuing improvement of "Genetron" refrigerants.



This giant fluorochemical center in Baton Rouge, La., makes many of the fluorine-based compounds required by industry and is a major production center for "Genetron" refrigerants. "Genetron" refrigerants are also manufactured in Danville, Illinois. Soon a new plant in Elizabeth, N. J., will provide a large new source for "Genetron" refrigerants.

What do rockets have to do with genetron super-dry refrigerants?

Just this. Part of the "big push" into outer space may come from fluorine-based propellants now being supplied by General Chemical to the nation's rocket and missile research centers. The same know-how that makes General Chemical the leader in fluorine chemistry applies equally in other areas—especially in the development and production of "Genetron" fluorinated hydrocarbon refrigerants.

Behind "Genetron" Super-Dry Refrigerants is a research organization which is internationally recognized for its work in fluorine chemistry. Even more important to every user of "Genetron" refrigerants are the Company's advanced manufacturing facilities, which have helped bring quality standards for fluorinated hydrocarbon refrigerants to new highs of purity and dryness—a major contribution in itself.

"Genetron" Refrigerants are approved, accepted, *preferred* because they are *performance-proved.* Refrigeration engineers, contractors and servicemen endorse them. Wholesalers recommend them.

It makes sense to rely on the leader in fluorine chemistry for fluorinated hydrocarbon refrigerants. Next time you order, insist on "Genetron" and be sure of the best! Available from wholesalers everywhere.

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

Look to the leader in fluorine chemistry... insist on "Genetron."

1